JUNE, 1965
2/6
Vol. 27 No. 3

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ELECTRONIC ELECTIONS

IN contrast to the streamlined, electronic methods which are being so widely adopted nowadays in the scientific, commercial and educational fields, the N.S.W. State elections, just completed, provided a classic example of doing things in the old-world manner.

In hundreds of polling booths, all over the State, electoral officers painstakingly checked names on rolls, then initialled and handed out the individual ballot papers on which the votes were recorded. Later, when the boxes were opened, every single paper had to be unfolded, read, checked and allocated. While this was going on, and for a couple of weeks after the election, there were endless arguments about errors in counting, double voting and malpractices of one kind and another.

Not surprising, there were many who found themselves comparing this tedious, old-world set-up with the data systems which are now being evolved to cope with such things as international airline bookings. Here, "paper" methods are giving place to central electronic data systems, which can store flight information for months ahead, accept seat bookings without fear of duplication or error, offer alternatives and record such incidental information as hotel and hire car bookings — all in a matter of seconds.

Why not, then, an electronic system for recording, counting and analysing votes, using minimal equipment at the booths but with a network of co-opted lines feeding back into a central data system?

Technically, such a scheme is undoubtedly feasible but the initial cost and organisation to put it into effect would be enormous, even allowing for "free" use of lines and temporary diversion of existing data-processing equipment.

No less important, the "human" aspect would need exhaustive investigation. Merely to press buttons in the hope that they were operating some distant register would be unsatisfying to voters and candidates alike. The best approach might well be a system of mechanically punched cards, which would show that a vote had been recorded and which would thereafter be suitable for electronic processing and checking.

The subject is one which warrants nothing less than long-term study by a joint Commonwealth/State commission.

N. J. Williams

June, 1965

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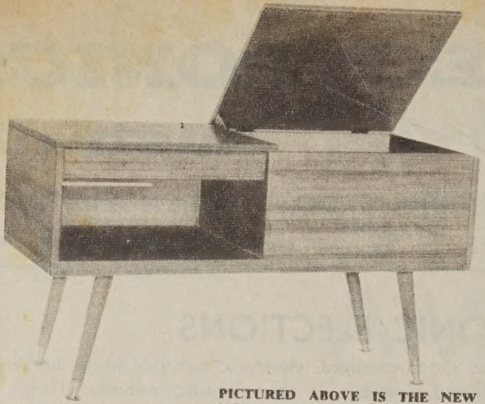

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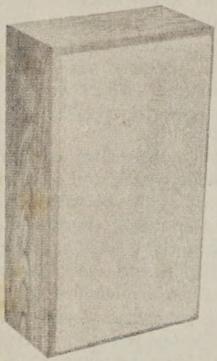

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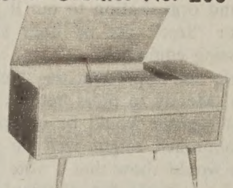

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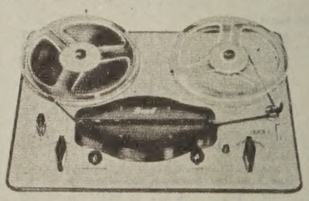

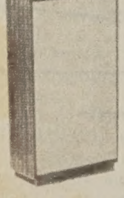

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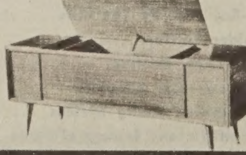

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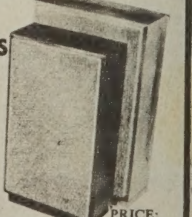

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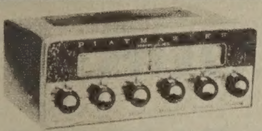

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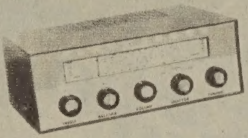

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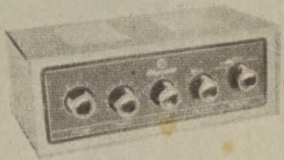

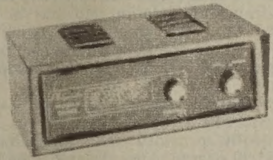

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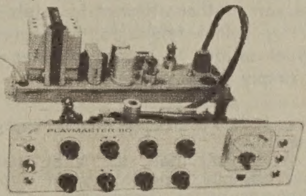

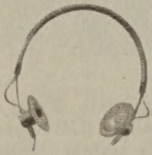

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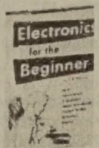

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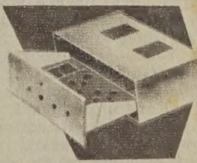

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EUROPE AND THE COLOUR TV CONTROVERSY

On March and April last, Study Group XI of the International Radio Consultative Committee (CCIR) met in yet another attempt to establish mutually acceptable system standards for colour television. No agreement was reached, leaving the individual nations to choose whether to "go it alone," regroup or simply wait and see.

AT the same time, the Australian authorities are watching the European scene very closely. In Parliament recently, the Postmaster-General, Mr Hulme, indicated that quite apart from economic considerations, the questoin of standards would have to be resolved before Australia could consider a colour TV service. The position in Europe, as it ultimately develops, would have a marked bearing on Australia's decision.

Why, many people have been asking, has it taken so long to determine which of the three systems — NTSC, SECAM and PAL — is the best? Could not engineers have carried out tests and within a couple of months come up with a clear and unamgibuous verdict?

To appreciate the reasons for the long-drawn-out arugments, stretched over many meetings of the European Broadcasting Union Ad Hoc Committee on colour television and the higher-level CCIR meetings which so far have failed to reach agreement, it is necessary to trace briefly the history of colour television which actually began with a demonstration by John Logie Baird as long ago as 1928.

The first public colour service began in the United States in 1951 using a system developed by the Columbia Broadcasting System. A major disadvantage with this system was that the transmissions could be received only on a colour receiver, whereas parallel development had by then shown that it was possible to devise a compatible system which would allow black-and-white receivers to display a monochrome picture from the same transmissions.

So, even while the CBS system was operating, a number of American organisations and manufacturers were co-operating through the National Television System Committee (NTSC) to evolve a new compatible system. The resulting system, known as NTSC, owed much to the pioneer work of the Radio Corporation of America at the end of World War II but with some notable improvements.

After field trials, the NTSC system was officially approved by the Federal Communications Commission and was brought into use on January 1, 1954, as the standard American system. It has since been adopted in Japan and also in South America.

By Patrick Halliday

It can be fairly claimed that the NTSC system resulted from almost eight years of continuous development work, first by RCA and later by almost the entire American industry. All engineers who have worked with the system have paid tribute to the ingenuity of the solutions found to the problems involved in devising a fully compatible system occupying no more bandwidth than the equivalent black-and-white system.

Briefly, NTSC is a three-colour system based on the principle that almost any colour can be defined in terms of the amounts of red, green and blue light present in the original picture element.

By combining the three colour components in definite proportions, a signal corresponding to a black-and-white transmission—the luminance signal—is created.

Two further signals are derived, each formed by combining the red and blue components in different ways with the luminance signal. These two additional signals, providing what is termed the chrominance information, are then encoded with the luminance signal into a single transmission.

With NTSC, the method of encoding is to transmit the two chrominance signals on a single sub-carrier which, for a 625-line system, is approximately 4.429687MC (a multiple of half the line-scanning frequency). The means adopted to allow two different signals to be modulated on to a single sub-carrier is termed quadrature modulation and may be compared with the manner in which two stereo sound tracks are recorded on the single track of a stereo gramophone record.

It depends essentially on our ability to transmit two AC-wave forms independently provided that these have a basic 90 degree phase difference and that we subsequently use a detector which is sensitive to phase. The sub-carrier is thus modulated both in amplitude and in phase and is thus sensitive to changes in either of these characteristics.

The actual sub-carrier is not transmitted with NTSC but is suppressed during the modulation process so that only the sidebands are transmitted. By careful selection of the nominal sub-carrier frequency, these sidebands can be mixed with the main luminance signal in such a way that they have relatively little effect upon a black-and-white receiver.

In an NTSC colour receiver, all these various signals have to be separated and recovered and then applied to the display which, until recently, has always been the Shadowmask cathode ray tube containing three separate electron guns, originally developed by RCA.

To recover the chrominance information, it is necessary to use synchronous detection requiring the reinsertion of a locally generated sub-carrier locked in frequency and phase to the original suppressed sub-carrier.

To enable this to be done, short colour bursts of sub-carrier are transmitted during the back porch of the line sync periods to enable a local crystal-controlled oscillator to be synchronised with the high degree of accuracy which is necessary.

Once the two colour-difference signals and the luminance signals have been recovered, it is possible to derive from these the basic three colour signals which are reproduced by means of the shadow-mask tube.

There is no question but that, with the transmitter and receiver correctly set up and with a good propagation path between them, the NTSC system provides excellent colour pictures. This is recognised even by those who prefer the rival systems which, in fact, have very many points of similarity with NTSC.

It was soon noted, however, that NTSC put extremely exacting requirements on the transmitters, studio equipment and the links between them, and depended for faithful colour reproduction on the reasonably accurate setting of a number of controls at the receiver.

For instance, the precise setting of the reference oscillator for re-injecting the sub-carrier, governs the hues. For final adjustment a user control is always provided (though some engineers consider that this could be eliminated with the latest techniques). Many Europeans who have watched colour television in the United States have complained that the user hue control is often incorrectly set.

And when in the late 'fifties magnetic tape recorders for television were developed by Ampex and RCA, it remained for some years impossible to record colour pictures in this way.

These and other considerations led some engineers—particularly those outside the United States where no regular colour service had been established — to continue the search for improved techniques, which did not depend to such an extent upon the rather tricky characteristics of phase plus amplitude.

TWO NEW SYSTEMS

Many different systems and techniques were evolved, but most of these were soon eliminated from serious consideration. Where they did overcome the phase problem, they tended to introduce new problems or else resulted in very expensive receivers. But two systems were deemed worthy of further consideration these were SECAM (the name is derived from a combination of the French words for "sequential and memory") and PAL ("phase alternation line").

The SECAM system, originally developed by M Henri de France and in recent years by the Compagnie Francaise de Television—a company specially set up for this purpose by the large French electronics firm CSF, and a major French glass manufacturer Saint-Gobain —has passed through several phases.

Basically it is distinguished from NTSC in that no attempt is made to transmit the two colour information signals simultaneously but, instead, these are sent one at a time consecutively during alternate line periods. This eliminates the need for quadrature modulation and synchronous detection in the receiver, with their requirement for accurate phase conditions

On the other hand, the SECAM system requires a special "delay line" in the receiver in order to store the colour information transmitted during one line period so that it is also available during the subsequent line period. By this means, during any line period, both colour signals are available simultaneously even though only one is being transmitted at any time.

With a 625-line system, the delay line has to store the signals for exactly the period of one line—that is 64 microseconds.

In the original SECAM system, the colour information was transmitted simply by conventional amplitude modulation of a sub-carrier, but the system was later improved when a change was made to frequency modulation of the sub-carrier. As in NTSC, the main carrier is modulated with the luminance signal.

With the elimination of quadrature modulation and the substitution of a rugged FM sub-carrier, the signal is much less susceptible to the various forms of distortion, such as differential-phase errors and differential-gain errors, which can seriously mar an NTSC picture. One result is that a SECAM signal can be sent much more easily over long microwave links or coaxial cable links between studios and transmitters, and it can also be recorded on magnetic tape almost as easily as a black-and-white signal.

At the receiver, with no synchronous detectors or reference oscillator, there is no need for a user-operated hue control.

Since only one colour-difference signal is being transmitted at any given time, instead of the two with NTSC, it might be thought that the vertical colour definition would be seriously impaired. Theoretically this is so.

However, it is one of the fundamental principles of colour television that what the eye cannot detect does not matter. The eye views colour much more crudely than black-and-white picture definition (a fact which allows children to produce good coloured pictures provided that they are given a black-and-white outline to work upon).

So this halving of the vertical colour resolution has little or no effect in normal circumstances. In practice, as SECAM supporters point out, the horizontal colour resolution of both systems is reduced to an even greater extent by band-width limitation.

The PAL system did not arrive on the colour scene until 1962. It was devised by Herr W. Bruch of Telefunken, whose fertile brain had earlier produced a number of colour systems as well as many of the standard circuits used in black-and-white television receivers. He has told me how he first became dissatisfied with experimental work on the NTSC system and turned to SECAM but found that this had, in his opinion, a number of limitation and so set about developing his own systems.

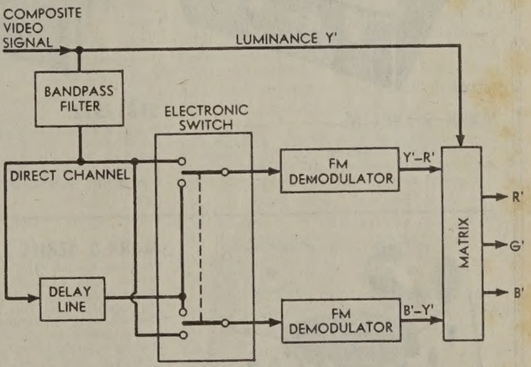
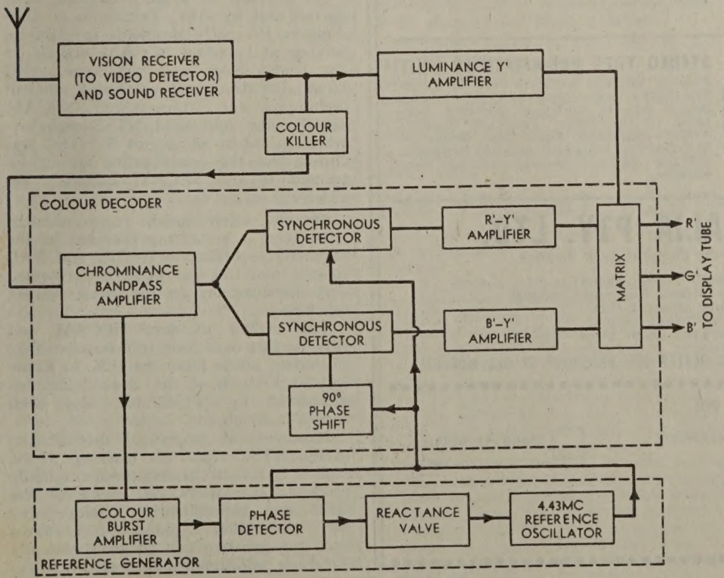


Figure 2, right: Simplified decoder for a SECAM receiver.

Figure 1, below: Basic outline of a typical NTSC receiver.



The most promising of these PAL, is in many ways a development of a system investigated in the United States in the early fifties but passed over in favour of NTSC, combined with receiver techniques of the SECAM system.

It differs from NTSC only in one small but important respect; the phase of one of the two colour information signals is reversed between alternate line periods. By this means, phase errors in the studio equipment, transmission links, propagation path and in the receiver—which would otherwise result in the need to compensate for incorrect hues—are averaged out between one line and the next, and are not apparent to the viewer.

This process of averaging out may be carried out by the eye or aided by the incorporation in the receiver of a delay line similar to (but more critical than)

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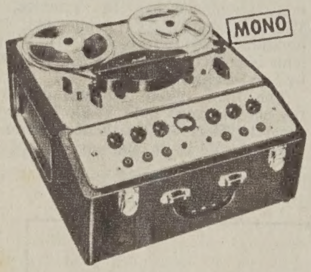

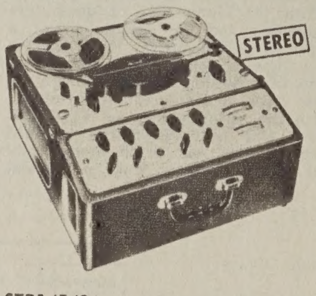

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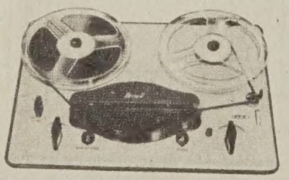

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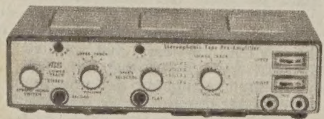

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that for SECAM and such a receiver has been termed "PAL de luxe"; however, this is not absolutely essential and it is usually envisaged that if PAL were adopted most receivers would not have a delay line—this type of set has been called "People's PAL."

A PAL receiver needs an electronic switch to correct the reversals of the phase before the signals are applied to the picture tube, but otherwise is almost identical to those for NTSC systems, though with less stringent stability requirements.

All three systems have been subjected to field trials in the United Kingdom, and there have also been extensive tests of one or more of the systems in a number of other European countries. France, for example, has recently carried out a major trial with SECAM, and NTSC has been extensively tested in Holland. Some important trials in mountainous areas were also carried out in Switzerland. What have all these tests shown?

In the first place, all three systems have proved capable of providing excellent colour pictures. Under the type of conditions which many would view colour, the differences between the systems as reproduced in the home would be so small that they can be disregarded for most practical purposes.

"SILVER FISH"

During BBC tests in 1963, the SECAM signal definitely gave inferior results under extreme fringe conditions due to the appearance of a granular moving background known as "silver fish." However, CFT then proposed certain changes in the amplitude of the sub-carrier and in the filters, and the modified system (sometimes called SECAM3) has proved much less susceptible to this effect.

Almost all colour engineers appear to accept the CFT claim that SECAM signals offer fewer problems to the transmission engineer, being easier to handle over long transmission links and much easier to ecord on tape. PAL is generally placed between the other two in these characteristics.

As a result of a great deal of work carried out by ABC Television at Teddington, the early problems involved in mixing and fading SECAM signals in the studio have been overcome. ABC have also developed extremely efficient techniques for "transcoding" SECAM signals into equivalent NTSC signals—which could be important if NTSC was chosen but the broadcasting authorities wanted to use SECAM encoding for video recording, etc.

On the other hand, recent months have seen a great improvement in the magnetic recording of NTSC and PAL signals, and this can now be performed very satisfactorily on the latest Ampex machines.

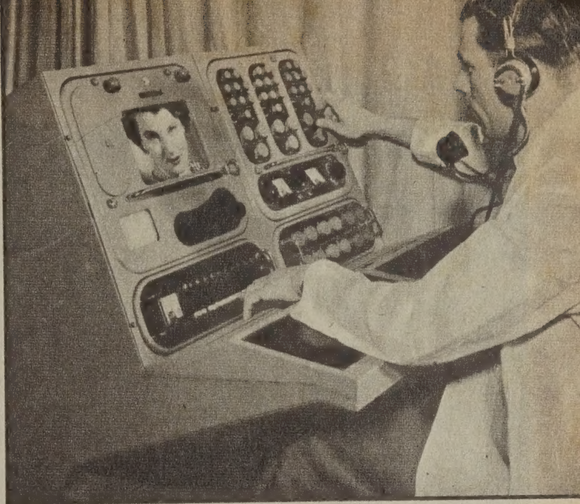
The ability to send SECAM and PAL signals over long transmission links (including relays from the U.K. to Rome and back) without the close tolerances demanded by NTSC has also been shown fairly clearly.

However, an important modification to the NTSC signal (at least up to the time it is actually transmitted) originally proposed by Dr N. W. Lewis of the GPO and subsequently developed by BBC and GPO engineers, has shown that this problem can be overcome. By attaching additional pilot reference signals to the NTSC colour signal these can be used at the distant end to provide automatic compensation for errors in differential-phase and differential-gain along the links.

All three systems are "compatible" and reproduce good black-and-white pictures on conventional receivers, but it is true to say that some have proved more compatible than others. In this respect NTSC has been widely judged to have the best performance, followed by PAL with SECAM third and with SECAM3 considered rather poorer than with the earlier SECAM parameters.

This is clearly an important point in favour of NTSC since, for many years, most viewers will continue to use monochrome sets but too much should not be made of it since the overall difference between NTSC and SECAM3 is so small that most viewers would be unaware of any significant difference, even though these could be detected by trained observers.

With SECAM, the FM sub-carrier is present within the luminance channel at all times, whereas with NTSC and PAL the strength of the chrominance sidebands depends upon the "Colourfulness" (saturation) of the picture element, and for much of the time is very low.



The British Broadcasting Corporation has been experimenting actively with NTSC colour since the mid-fifties and was keen and ready to start a public service. Britain's present problems with dual-standard and UHF television have reduced the chances of the nation "going it alone" with colour.

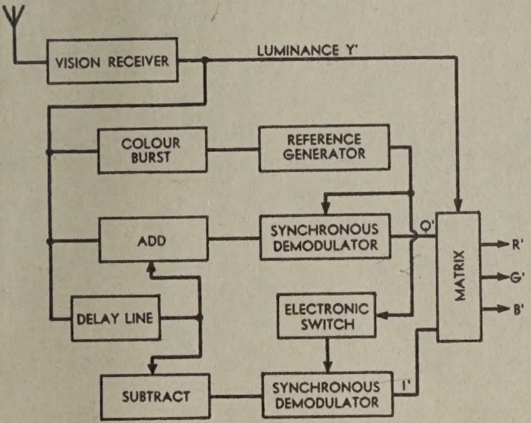


Figure 3, left: Simplified decoder for a "PAL de luxe" receiver.

Field trials in mountainous areas have tended to show that NTSC is more susceptible to multipath reception than the other systems—with PAL proving particularly effective in such conditions. It should be remembered that whereas in the United States colour transmissions are mostly on VHF., in the U.K. it is intended to radiate colour only on the 625-line system which, at least for a number of years, will be located on UHF. The UHF transmissions are generally considered to be more prone to multipath conditions.

However, it is only fair to state that the BBC field trials do not suggest this is a major problem except possibly in a few hilly areas. An important claim for PAL is the ease with which it can be handled by low power, unattended "satellite" transmitters.

What of receiver costs? NTSC receivers can draw upon many years of development work and production statistics in the United States and can thus be accurately costed. PAL receivers must inevitably be rather more expensive to manufacture than those for NTSC because of the electronic switch and possible inclusion of a critical delay line. Nevertheless, compared with the total cost the difference would be a small one, especially for the "People's PAL."

The exact cost of making SECAM receivers in large numbers is still to some extent a matter of speculation, although several organisations have prepared reasonably detailed figures. Much depends upon the cost of the delay line — the cost of which would fall with mass production.

Suitable delay lines can be made from quartz or glass, but in 1963 CSF, the parent company of CFT, developed a delay line using steel which has so far proved very satisfactory for this purpose and which it is claimed could be produced cheaply for large numbers.

The latest estimates thus put NTSC and SECAM receivers very close, though there is a greater degree of estimation involved in the SECAM figures. CFT believe that with some further development, now well advanced, the SECAM costs could be brought below those of NTSC. But clearly there would not be any major difference between the two.

How much importance should be attached to the simplification of receiver controls which is possible with SECAM? Those who support NTSC say very little, and some go so far as to say they prefer to have controls for hue (phase) and saturation (amplitude) available. On the other hand, most of the European receivers have been operated in the homes of engineers and others with a technical background. There is evidence from the United States that such controls are often incorrectly set by non-technical viewers.

However, in all three systems, colour reception is also affected to some extent by the setting of the fine tuning control, and it is this control which tends to be blamed most often for any poor colour reproduction. A strong case can be made for the incorporation of automatic frequency control circuits in colour receivers.

One final argument which is sometimes advanced in favour of NTSC is that this system would be easier to use in conjunction with single-gun colour display tubes, should these ever come into widespread use. So far, apart from one Japanese receiver which is to be marketed shortly using a chromatron (Lawrence) single-gun tube, all production receivers for all three systems have utilised the three-gun shadowmask display tube.

To sum up. All three systems have proved to be capable of providing a

(Continued on Page 126)

THE PRESENT POSITION:

SECAM is supported strongly by France, favoured by Russia and won most votes. However many such votes came from countries with little or no television background.

PAL attracted solid support from W. Germany, Italy, Switzerland, the Scandinavian countries and New Zealand.

NTSC attracted fewest votes but it has the benefit of highest development and powerful backing from the Americas, Japan, Britain and Holland.

COMPROMISE: An admixture of systems could emerge, one as the basis of international network operation, others the basis of local transmission. PAL and NTSC could "get together" most easily.

POLITICAL considerations are probably as significant to agreement as technical. At the conference the initials were accorded new meanings: NTSC—Never Twice The Same Colour; SECAM — Something Essentially Contrary to the American Method; PAL—Peace At Last.

AUSTRALIA: Australia's modern and unified TV system could move into colour with a minimum of technical complication, based on any of the above systems. When it should do so is more a matter of economic planning. The Broadcasting Control Board has made no recommendations. The Postmaster General stated recently, "I do not expect to receive any advice on the introduction of colour television for a long while in the future."

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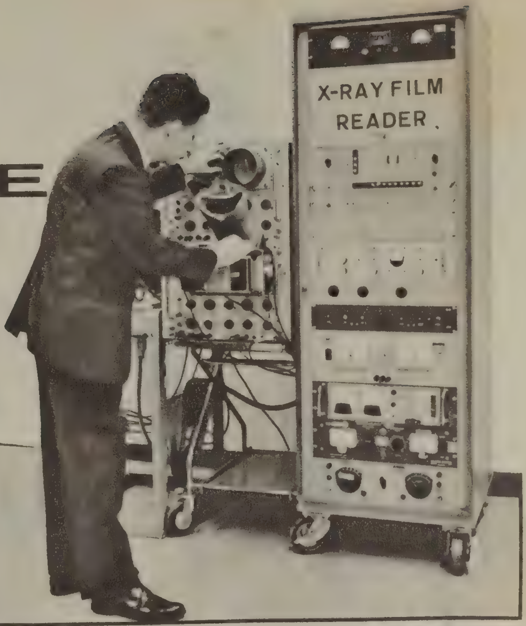
X-RAY FILM BY THE MILE

An automatic, computerised method of reading X-ray films to detect flaws in welded seams was announced recently by the Lockheed Missiles and Space Company. What was formerly a mammoth problem has been cut down to size.



Nicholas Szabo, with the Automatic X-Ray Film Reader he and others have developed at the Lockheed Missiles and Space Company. The general purpose computer is not shown.

SPACE and defence programs dealing with huge tubes and vehicles have enormously increased the amount of welding that must be checked for critical reliability, since a welding flaw could lead to the destruction of a vehicle costing millions of dollars.

For example, one mile of film has to be read for each Saturn booster. By present methods, human scanners must check every inch of this film for flaws and record any defect. Not only is this process time-consuming, but it also contains many uncertainties.

The new system reduces the time to check a 100ft roll of film with an average of one defect per foot, from 450 to 40 minutes, or less than one-tenth the time.

The flexible computer detection method allows criteria for a flaw to be programmed into the machine for any desired flaw size or proximity to other flaws.

A piece of metal is X-rayed much as a person's chest is X-rayed. The film is developed for maximum contrast and run through a projector. The projector projects a nine-tenths inch section of the weld on to a TV vidicon tube. The tube scans the image and produces a video signal which is fed into the Video and digital processor unit, the heart of the system.

In the processing unit the image is examined line by line (approximately 400 lines constitute the TV frame which corresponds to a .9 x 1.2-inch sector of the film) for any flaws. Each line is then divided into 230 points. Corresponding to each point a binary number (0 or 1) is then transmitted to the general purpose computer, depending on whether or not a flaw exists at the particular point.

Hence, for each line a 230 (binary) digit number is transmitted to the general purpose computer. In the memory of the computer all the information of one frame is assembled, i.e., 230 digits for each of the 400 lines. The flaw pattern has now been transferred into a memory mosaic. A routine then analyses the pattern and produces a list of the geometric configurations of the flaws.

The program currently in use is quite flexible; that is, it allows broad latitude in the choice of criteria for a reportable flaw. A typical set of criteria would be: Report all flaws which are larger than .030in in one direction and .010 x .010 and, at the same time, closer than .100in to another flaw in the same size or greater.

As the end result, a high-speed typewriter prints out the findings of the detection process, listing the size of the flaw, its position, its proximity to other flaws.

For on-line inspection applications, a direct reading of the flaws will be pos-

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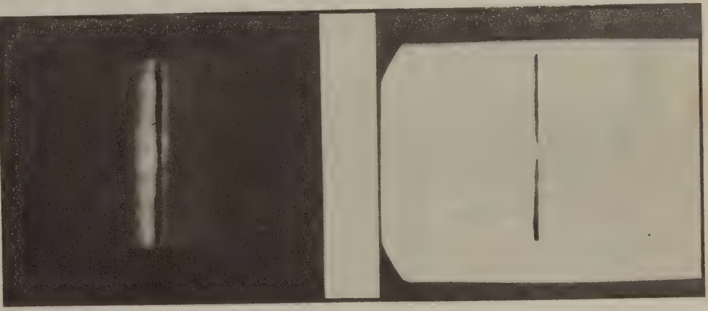

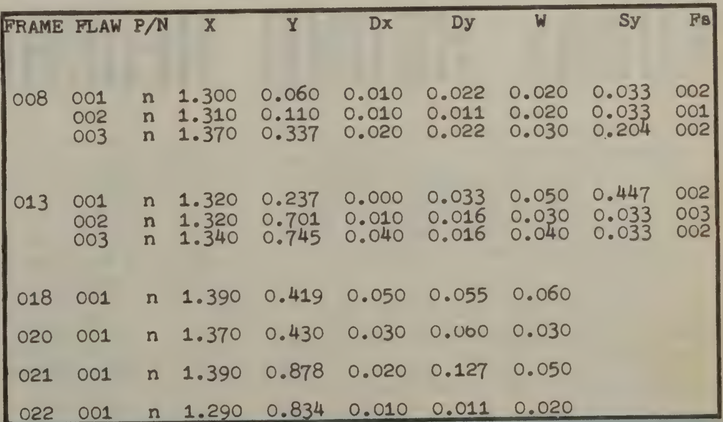

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FRAME FLAW P/N   X      Y      Dx     Dy     W      Sy     Fs


008   001   n  1.300  0.060  0.010  0.022  0.020  0.033  002
      002   n  1.310  0.110  0.010  0.011  0.020  0.033  001
      003   n  1.370  0.337  0.020  0.022  0.030  0.204  002


013   001   n  1.320  0.237  0.000  0.033  0.050  0.447  002
      002   n  1.320  0.701  0.010  0.016  0.030  0.033  003
      003   n  1.340  0.745  0.040  0.016  0.040  0.033  002


018   001   n  1.390  0.419  0.050  0.055  0.060

020   001   n  1.370  0.430  0.030  0.060  0.030

021   001   n  1.390  0.878  0.020  0.127  0.050

022   001   n  1.290  0.834  0.010  0.011  0.020
```

Top left: X-Ray negative of flaw detected in a welded seam. Top right: The high contrast print of the flaw that is fed into the computer where its size, shape and position are analysed and recorded. Bottom: Typical report that is printed by computer after inspection of sequence of pictures showing distance along weld, location of flaw, size and proximinity to other flaws.

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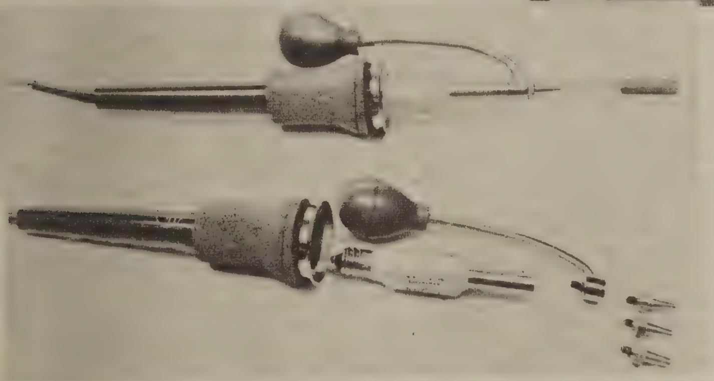
From SOLDER SNIFFER To SPACE GREASE

By Wesley Robinson

It's the little things that count in a big space project —little things like printed circuit boards and a lubricant that stays that way up yonder!

SOLDER SNIFFER: Soldering hair-sized wires to a printed circuit board the size of a ham sandwich is difficullt. Even more difficult is the job of removing soldered connections from this electronic circuit. A plastic film over the circuit board must be cut through, the part loosened and the pinpoint of solder lifted cleanly from the surface.



This process is known as desoldering. Transistors, capacitors and resistors on Minuteman circuit boards occasionally must be de-soldered and replaced.

When the first Minuteman circuit boards were returned to the shop for desoldering, a method was used which was only partly satisfactory. The board's plastic film was chipped away, a fluxed wire braid was placed over the exposed solder and a heated soldering iron pulled the solder into the braid.

Usually the solder came away cleanly. Sometimes, though, the wire braid was not lifted soon enough and would solder itself tightly to the circuit board.

Manufacturing development engineers at Boeing studied the problem and one of them came up with an ingenious tool called a Solder Sniffer. It works quickly and perfectly every time.

The tool is an adaptation of a standard pencil-type soldering iron. Instead of a straight soldering tip in the iron's heating unit, Boeing placed a small hollow adapter between heater and point, with a short length of stainless steel tubing from the adapter to a small rubber bulb.

Using a special hollow tip, the hot Solder Sniffer burns cleanly through the plastic film, melts the solder and sucks it completely off the board in one simple seven-second operation.

Capillary action starts the solder flowing into the hot, hollow tip, but suction from the rubber bulb is what actually cleans the melted solder from the circuit board's surface. The Solder Sniffer never plugs up, since a simple squeeze of the bulb expels any solder remaining in the tip.

The tool would be a bargain at several times the low cost of making it. The Solder Sniffer virtually has eliminated ruined circuit boards and saves time as well.

SPACE GREASE: How do you lubricate your spacecraft when you're 20 million miles from earth?

Oil and grease freeze or evaporate in outer-space extremes. Graphite turns into an abrasive. But the myriad complex moving parts in a spacecraft's heart must be lubricated, nevertheless.

A spaceman confronted with the problem of choosing the right space lubricant would do well to check with Boeing's Aero-Space Division materials and processes group. It has devised bearings and gears which will lubricate themselves.

An expected important application of the new lubrication system will be in manned orbital laboratory programs. The trick is to combine a lubricant that works in a vacuum with a metal that is difficult to melt. Once compounded, this unusual substance can be formed into circular bands with holes cut out to contain the ball parts of ball bearings.

As the bearings turn, the balls rub lightly and easily against this metal-lubricant band, picking up a thin film of lubricant. The ball in turn smears lubricant onto the ring in which it rolls.

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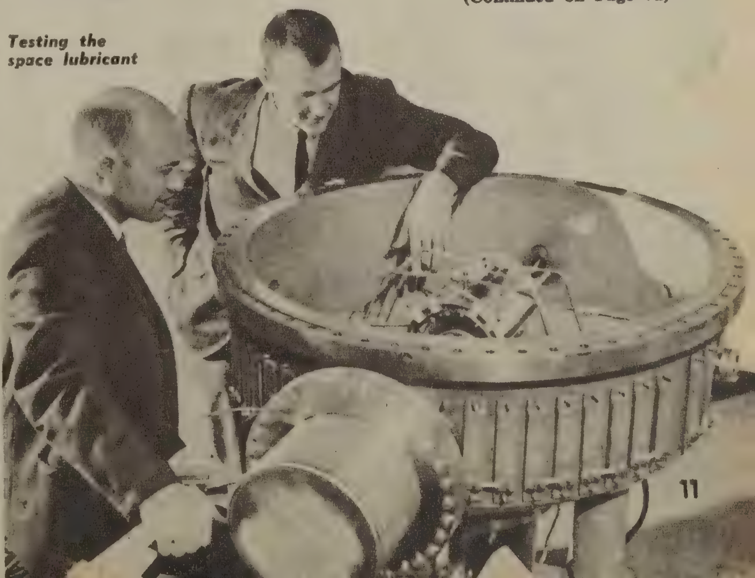
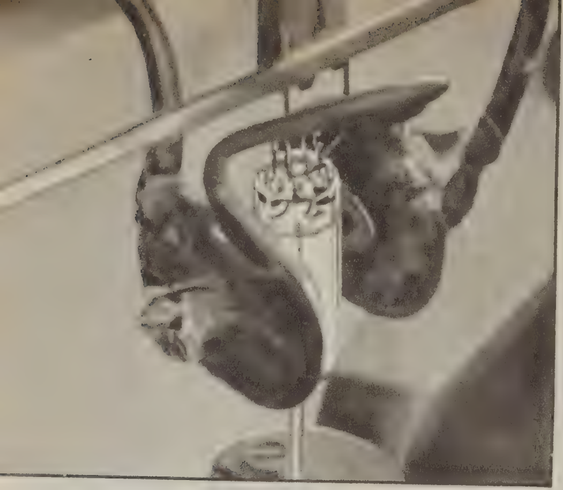


Testing the space lubricant

Induction and Dielectric Heating

By Calvin Walters



During valve manufacture valve elements are raised to red heat, while under vacuum, by induction heating. This releases occluded gases, which are drawn off by the vacuum pump. (Photo by courtesy Amalgamated Wireless Valve Co.).

In the April issue of "ELECTRONICS Australia," the Basic Radio Course, chapter 20, dealt with induction and dielectric heating. In view of the importance of this type of heating to industry some enlargement of the subject is appropriate. Such is the purpose of this article.

UP to the time of the introduction of electricity as a source of energy, man's only source of heat was the flame. This was generated either by means of a coarse fire or, at later stages, by jets of coal gas, acetylene, etc., or by liquid fuels such as oil, kerosene, and so on.

Throughout history man has attempted to make more efficient use of the heat sources at his command. This became particularly important as industry developed, because the practicability of many processes depended on applying large quantities of heat over defined areas of a wide range of materials such as metal, wood, and plastic!

The development of electricity changed the course of industrial history because of the vast quantities of "flameless" heat and power which it made available. So that the importance of heat in industry can be more fully realised, a few applications are given in the following paragraphs.

Melting metals is, of course, fundamental to all metallurgical work. While this can be accomplished by induction heating, conventional furnaces are generally more efficient for large quantities. There are, however, small applications of induction melting, as by jewellers and goldsmiths, where well controlled induction heating is preferred to conventional methods.

An important heat treatment is that used for case-hardening metals. There are many parts, such as gear wheels, spindles, shafts, sawblades, cutting tools, screw taps and dies, etc., which are subjected to both wear and severe forces exerted upon them during use. To minimise these effects the steel is hardened to give it better wearing qualities.

The problem here is that hardened steel is brittle, whereas, in order to withstand the strain of great forces, it must be tough, and tough steel is soft. But there is no way of combining hardness and toughness throughout the entire material. The problem is solved by using a non-hardening steel, and then subjecting the outer surface to the action of carbon. This is called "case hardening" and produces a piece of steel tough on the inside and hard on the outside.

The classical method of case hardening is by heating the piece in a furnace and treating it with chemicals to produce an outer skin of high carbon content and an extremely hard nature. This kind of case hardening requires a lengthy controlled process of annealing in which undesired alterations in the structure and dimensions of the material can occur.

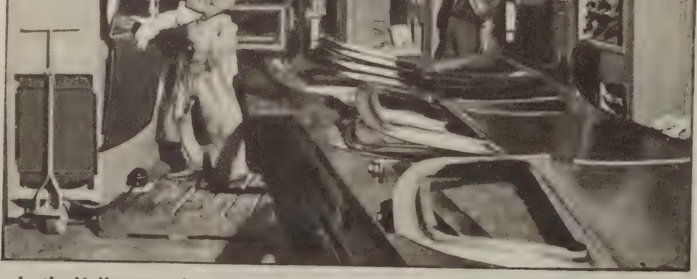
ALTERNATIVE METHOD

There is another method of case hardening where the object is made from steel which is hardenable. (All steel with a carbon content of above 0.3 per cent is hardenable.) This is surface heated and then quenched, but the process of surface heating requires the application of heat in extremely high energy concentrations in a very short period. Otherwise, conduction carries the heat too far into the material, the hardened layer is too thick, and the object lacks the required toughness.

In many ways, the latter method is the preferred one, since it needs much less time. Until recently, however, it has been difficult or even impossible to provide the large concentration of heat on the surface of the material. High frequency heating solved this problem, with the result that it is now a major application for this form of heating.

There are many workpieces which become too hard during processing. This is particularly so in the case of sheet steel which has been pressed into a shape, spun on a lathe, or drawn through dies. Unwanted stresses are set up in the material. If these are not relieved, the workpiece is weak at these points and is likely to fracture in service. The strains on the curved portion of car doors are an example.

Annealing is the process used to relieve these stresses. It generally means heating steel to temperatures between



In the Volkswagen factory in Victoria car doors which are shaped in the press on the right are transferred to the operator on the left who uses an induction heating unit to heat spectic parts of the door and relieve stresses caused by the shaping process. (Photo from Philips Electrical Pty. Ltd.)

50 and 800°C followed by a slow ooling process. This partially softens ne material, improves its structure and nakes it more ductile, so that its reistance to sudden variations in loading ; increased.

Annealing requires careful control of ne heat applied and induction heating ; very suitable for this work. However, its use is confined to tubular or at steel workpieces which are slightly ess than one-sixteenth inch thick because, since high frequency heating produces only a small heat penetration, it is nly in these instances that the work an be heated right through.

High frequency induction heating is ised extensively for soldering and brazng. The advantages here are that the iigh frequency induction heating gives juick and very uniform heating at the xact position of the join. Thus, less ieat is needed per join, soldering time is educed and oxidation of the work and hemical or structural changes in the naterial minimised.

When high frequency heating is compared with furnace or direct flame heating, several advantages become manifest. The power applied can be accurately controlled and is reproducible. There is a more constant supply of heat to the work but heating times, being much shorter, cause less oxidation and distortion of the work. The heating apparatus can be located alongside machines, thus saving much handling time.

COMPARISON

A comparison of the heat energy available from high frequency induction systems with that available from conventional methods has been supplied by Philips Electrical Pty. Ltd., to whom we are also indebted for much of the other information in this article.

With the aid of conventional heating methods, heat can be applied to a workpiece with an energy density of up to 0.5 watts per square centimetre (0.5W/cM^2) by convection, 8W/cM^2 by radiation, or 20W/cM^2 by conduction. By heating in an intense flame a maximum energy density of about 1000W/cM^2 can be attained, whereas with the aid of high frequency energy, densities of 10KW/cM^2 can be realised.

Induction heating is based on the generation of heat in conducting materials which are placed in a varying magnetic field. It is the kind of heat which, unwanted in such cases, is generated in electric motors, transformers, and so on. Such apparatus is designed to minimise the generation of heat while high frequency heating apparatus is deliberately designed to use such heat.

If we take a suitable coil, referred to in high frequency apparatus as a load or work coil, and pass an alternating current through it, an alternating magnetic field is set up around the coil. If we now place a piece of metal into this alternating field, currents are induced in the metal. These are called "eddy currents" and revolve inside the piece of metal in a direction opposed to the direction of current in the coil.

Because electrical resistance exists in all metallic material, these eddy currents will generate heat in the material, the electrical energy transferred into heat being determined by the well-known formula, $W=I^2R$ where W is the power in watts, I the current in amps and R the resistance in ohms. The resistance of the material to high frequency currents depends on such factors as the specific resistance, the frequency, and the relative permeability.

In magnetic materials such as iron, cobalt, nickel and a few others, the heat generated by eddy current losses is augmented by that caused by hysteresis losses. However, eddy current losses are much greater than hysteresis losses.

The classical explanation of hysteresis is the conception of magnetic material being made up of molecular magnets. When the material is subjected to an alternating magnetic field these magnets are forced to change their orientation by the effect of the changing magnetic field.

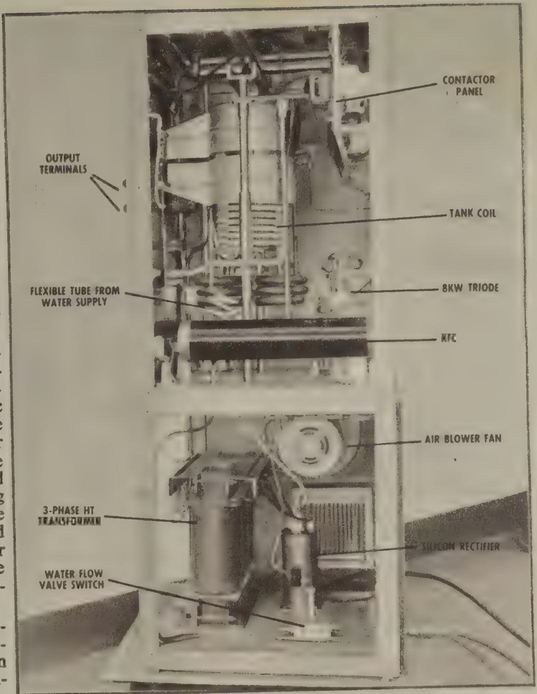
In being orientated, they experience a certain amount of molecular friction. In some materials this friction is quite low (in a magnetically "perfect" material it would be non-existant) and the magnets will, on removal of the magnetic field, return to a position very close to that from which they started. In others, the friction is high and the magnets will be only partially restored to their original position.

It is this failure to return completely to the original position that we call hysteresis, and the graphical representation of the phenomena is called a "hysteresis loop." Since hysteresis is a function of the molecular friction, the characteristics of the hysteresis loop and, particularly its area, give an accurate indication of the amount of molecular friction present and, hence, the amount of heat which will be caused by it when the material is subjected to an alternating magnetic field.

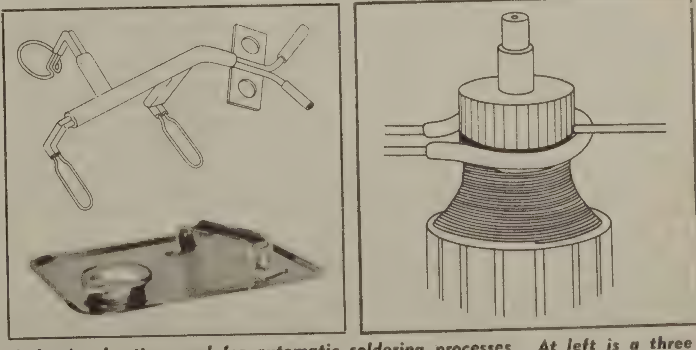
As might be expected, the higher the frequency of the magnetic field, the faster the molecules will have to move and the more heat generated.

Hysteresis losses occur only up to a temperature called the "Curie point" or "Curie temperature," which varies quite markedly for different materials — from 90 to 1,120°C, with transformer iron at 690°C. At this temperature magnetic material loses its permeability and therefore there can be no hysteresis. Apparatus is normally designed on the basis of non-magnetic material behaviour, which requires more power than magnetic material.

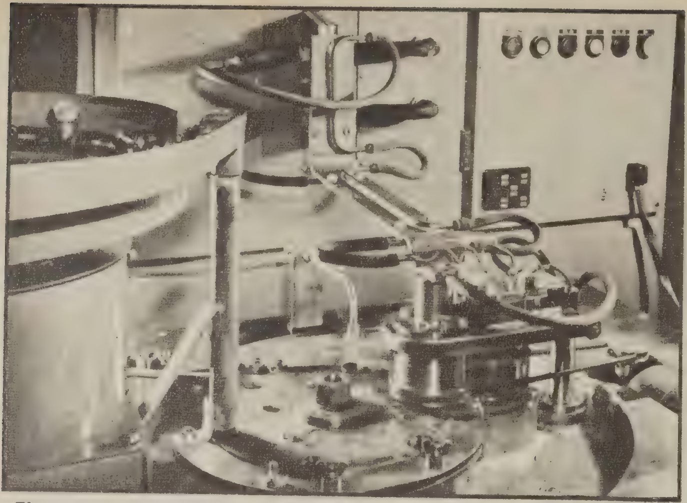
An important feature of high frequency current is the so called "skin effect." As the frequency increases current flowing through a conductor tends to concentrate near the surface. In a copper rod 1cM in diameter through



The 8KW RF generator described in the text. Note the size of the RF choke and tank coil, the latter being water cooled. (Philips Electrical Pty. Ltd.)



Induction heating used for automatic soldering processes. At left is a three loop work coil which heats both ends of a handle and a spout simultaneously. Soldering time is 2 seconds. At right a single loop heats wire ends and commutator segments in 4 seconds (Philips Electrical Pty. Ltd.)



The set-up for hardening needle cup races, described in the adjacent column. The races are fed from the top left, down the vertical chute to the slotted disc. As this rotates it takes the race under the heating coil on the right and the quench spray just behind it. (Philips Electrical Pty. Ltd.)

which a current of 1MC is passed, nearly all the current flow is restricted to a skin of only 0.1mM thickness at the surface.

This skin effect is a very important factor in the case hardening process already discussed for, by selection of suitable frequencies, the thickness of the hardened layer can be accurately controlled. It follows from the above that the lower the frequency the deeper the current flow in the material. This is true and, where material must be "through heated" as in annealing more solid material than sheet steel, lower frequencies are used.

In another approach to "through" heating the skin effect phenomena is offset by applying less power, raising the temperature more gradually, and allowing the heat generated on the outside to penetrate to the centre. In such cases, the amount of power supplied can be quite critical.

This is important where both magnetic and non-magnetic materials are to be handled. Since, in the case of magnetic materials, hyteresis losses will be added to the eddy current losses, these materials will heat more rapidly, for a given amount of power, than non-magnetic types. Thus, the amount of power required for non-magnetic materials may prove too great for magnetic types, resulting in too rapid heating and a failure of the centre of the material to reach the required temperature within the required time.

REDUCED POWER

Since this is an undesirable condition, high frequency generators such as the Philips unit to be described later, are fitted with a timing arrangement which causes lower power to be applied to magnetic materials for the first part of the heating cycle, up to the Curie point, to offset the additional heat generated by hysteresis. After the Curie point is passed, and hysteresis no longer exists, the power must be increased to that needed for non-magnetic materials.

Modern high frequency induction heaters use valve generators and a representative circuit was given last month in the Basic Radio Course. A picture is given here of an 8KW generator manufactured by Philips Electrical Pty. Ltd. Other models are made to deliver power from 2KW to 200KW and from frequencies from 200KC to 1MC. The 200KW version operates at 200KC and the 2KW unit at 1MC.

DESCRIPTION

The apparatus pictured has an 8KW valve oscillator cooled by an air blower fan. Power is supplied from a 5000 volt three-phase high tension transformer. Rectification is by a silicon diode rectifier. The tank coil consists of copper tubing through which cool water flows. The output is taken from two water cooled coils surrounding the tank coil. To vary the power output the tank coil can be moved in and out of these coils by a handle on the control panel.

The tank coil, output coil, and work coil are all of copper tubing through which water is constantly flowing. In order to guard against failure of water supply a water flow valve switch is inserted in the water supply. As water flows it operates a switch, connected to the power supply. Thus, power can be applied to the apparatus only when water is flowing. Other contactors protect different portions of the apparatus.

Output from the generator is taken from two terminals on the front panel. To these terminals are connected the "work coils" which are really extensions of the output coil. These "work coils" are a vital part of the set-up because they do all the work of heating the work piece. The efficiency of the system depends on the manner in which the power is transferred to the object to be heated.

The work coil can be one turn of copper tube surrounding the part of the work piece to be heated. It can be a large coil with many turns or a "coil" of flat material. The principle is that the coil should follow as closely as possible the shape of the object to be heated. Thus the coils can be of many shapes or sizes.

Where necessary, extension leads are used to locate it some distance from the generator. If desirable, it can be enclosed in a vacuum or enveloped by an inert gas, when it is desired to heat a material in a special atmosphere or atmosphere free environment.

Work coils are usually made specifically for the job in hand. A typical example is the work coil used in the B.M.C. motor works in Sydney for hardening teeth in motor car ring gears. This work coil surrounds the gear. When the desired temperature has been reached the gear is automatically raised from the coil and quenched with water. In the Volkswagen works at Clayton, Victoria, stresses are relieved in the curved portion of car doors by surrounding the portion with a work coil and heating the curved steel.

AUTOMATIC PROCESSES

Because of the accurate control possible with high frequency induction heating, it is easy to provide for fully automatic operation of heating processes. This is an enormous step forward from conventional methods. Selective heating is also a feature, as the work coil need surround only a small portion of the workpiece which is then subjected to high frequency current.

A typical automatic set-up is used for hardening automotive needle race cups. The cups are fed from a vertical chute to the work table, where they drop into suitably shaped slots on the periphery of a revolving disc. As the disc revolves it moves the cups first under the heating coil, where the temperature is quickly raised to the required level, then under a quench spray, and finally ejects them. Such a system can harden 400 cups an hour.

Induction heating is also used in "radio" valve manufacture, as illustrated at the beginning of this article. A vital requirement for these valves is that they have a high order of vacuum; the higher the better. Moreover, they must retain this high vacuum throughout their useful life.

Pumping alone cannot guarantee this. Gases are contained within the metal parts of the valve and may be released after the valve is sealed, particularly if these parts are heated. To avoid this it is necessary to heat the metal parts during pumping and while under vacuum.

BARRIER

This is not easy by normal heating methods. The vacuum forms a formidable barrier between any external heat source and the metal parts, and there would be a grave risk of melting the glass envelope.

Induction heating provides an almost ideal method, since the heat is generated directly in the metal parts. Also, as we have already seen, it lends itself to automatic operation, an essential requirement for the high-speed mass production methods used in valve manufacture.

Induction heating for melting metal is usually restricted to small quantities, say up to about 2½ pounds weight. A typical HF furnace suitable for such application is available from Philips Electrical Pty. Ltd., to whom we are indebted for details.

The material is enclosed in a crucible of non-conducting or conducting material depending on the nature of the "melt." If the material to be melted is non-metallic, no power can be generated in it directly and a crucible of conducting

(Continued on Page 126)

UNIQUE OFFERS FOR JUNE!

1 Pioneer SMB 161 stereo amplifier with AM/AM/SW tuners, Labcraft 605 turntable, All Balance tone arm with ADC diamond magnetic cartridge, two Wharfedale 8in RS/DD or Richard Allen speakers, £99/10/. If you prefer the Labcraft 643 turntable with ceramic diamond cartridge the cost is .. .. **£88** Retail £148.

2 The well known Star SA-30 or the Encel X1212 stereo amplifier, Labcraft 605 turntable, J.H. tone arm and ADC 770 cartridge, two twin cone 10in Wharfedale 10 RS/DD or Richard Allen speakers .. .. **£94/10** Retail £132.

3 Labcraft 605 turntable, Pritchard tone arm and ADC 770 cartridge OR Lenco GL88 turntable, J.H. A18 tone arm and ADC 770 cartridge .. .. **£39/15** Retail £60/10/.

4 Sansui SM34 stereophonic amplifier with AM/AM/SW/FM tuners, Labcraft 605L turntable, J.H. or All Balance tone arm with ADC 770 cartridge, two Wharfedale 10in RS/DD speakers **£144**

5 Leak "Stereo 30" solid state stereo amplifier, Labcraft 605L turntable, J.H. tone arm, ADC 660 cartridge, two Goodmans or Wharfedale 10in speakers. **£166** Retail £244.

6 Labcraft 643 turntable with stereo diamond ceramic cartridge, two 10in Wharfedale RS/DD speakers. Bargain basement rates. **£38**

7 Pioneer SMQ 300B stereo amplifier with AM/AM/SW/FM tuners, Silex transcription turntable, Ortofon SMG 212 tone arm and Ortofon SPU-GT-E cartridge two Goodmans 201 12in wide range speakers. Value at **£186**

8 Sony stereo tape recorder C/W microphones Trio W 10 tuner/amplification, Labcraft turntable with B and O magnetic cartridge (diamond stylus), two Wharfedale 10in RS/DD speakers Retail £256. **£178**

9 Philips turntable unit, 4 watts per channel stereo amplifier (6GW8's) with separate bass and treble controls, two Wharfedale 8in RS/DD speakers .. .. **£43** (with a Labcraft 643 turntable this unit costs £56.)

CELESTION COMES TO AUSTRALIA!

Studio quality Celestion speakers will be available at Encel Electronics soon. Models CX 2012 and CX 1512 are expected from the wharves in mid-June. Order now for early delivery!

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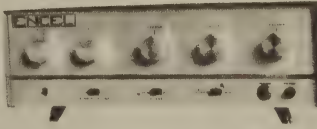

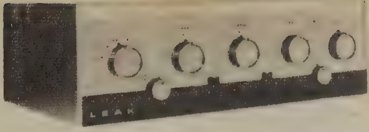

NOW IS THE TIME TO TRADE UP TO A LEAK 'STEREO 30'!

The new fully transistorised Leak "Stereo 30" is a magnificent unit—and gives outstanding results. Now is the time to trade in your old equipment at Encel Electronics—and to be agreeably surprised at your trade-in valuation! Solid state (fully transistorised) equipment is smaller in size, less in weight, creates no heat problem and has established a reputation for reliability. So enquire about your new "Stereo 30" now!

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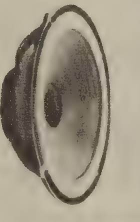

NEWS FROM KELLY!

Kelly Acoustics is now a subsidiary of the world wide Decca organisation, and production of Kelly speakers has been increased considerably. The international demand for Kelly units can now be satisfied. New stocks are arriving each month at Encel Electronics.

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This fine bass reproducer has a frequency range from 30 c/s to 5 kc/s and is rated at 15 watts. 15 ohm impedance. Designed for crossover frequency at 2½-5 kc/s.

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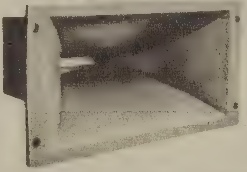

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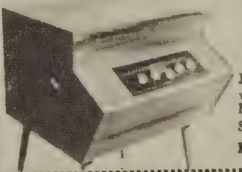

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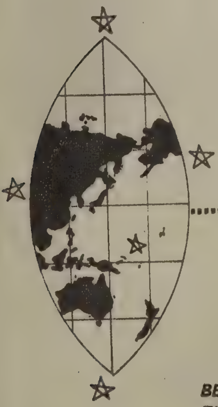

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SPEAKERS .. .. Kelly, Wharfedale, Richard Allen, Leak, Goodmans, Stentorian, Pioneer, Celestion.
PICK-UPS AND CARTRIDGES .. .. Ortofon, ADC, Decca, J.H., B. and O., Goldring, All-Balance, Shure, S.M.E., Pritchard.
TAPE RECORDERS .. .. Tandberg, Grundig, Akai, National, Philips, Sony, etc.
DICTATING MACHINES . Grundig, Stenorette, Philips.
TUNERS .. .. Chapman, Pioneer, Quad, etc.

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Technical Review

DRIVERS STAGE "ACCIDENTS" IN CAR SIMULATOR

The mounting toll of road accidents, in all parts of the world, is prompting traffic engineers to study the problem from all possible angles. To permit studying driver reactions under a wide range of driving conditions the American Goodyear Tyre and Rubber Company have produced a car simulator similar to the aircraft simulators used to train airline pilots.

JOE POTICNY slammed on the brakes and twisted the steering wheel hard right. Brakes squealed, horns blared, lights flashed and his Plymouth headed for a broadside collision with another car.

But there was no crash. All action stopped, and the scene froze a split-second before the inevitable collision.

"Okay Joe, let's call it a day," said the voice from a loudspeaker mounted in the car. Joseph Poticny, electronics engineer, climbed out of the driving-simulator car in which he had just completed another prelude to a "fatal" accident.

Accidents are Poticny's business at the Goodyear Tyre and Rubber Co's aerospace facility in Akron, Ohio. As manager of the simulator project, he is checking out an elaborate test system that will be used by the United States Public Health Service to find out how drivers react to dangerous situations.

The Goodyear simulator, financed by a $60,821 grant from the Public Health Service, will be used to check how drivers react under all kinds of road conditions and under many handicaps—drunkenness, fatigue, emotional upset.

Another simulator for long trips on superhighways, is being built by the Radio Corp. of America at its Defense Electronic Products division in Bethesda, Md. RCA has a $136,183 grant.

The Goodyear system uses a real Plymouth and a 12-by-18ft model of the streets around the plant. The car "travels" in and out of trouble all day without ever leaving its position in front of a high-gain, ellipsoidal projection screen. Other equipment includes a closed-circuit television system and two analog computers similar to those used in aircraft simulators that Goodyear built for the Navy.

The Plymouth, whose wheels barely touch the floor, is instrumented so that five kinds of data signals, representing the driver's handling of the car, are transmitted to the computers.

The signals are used to position the TV camera on the terrain model, where the camera represents the car. The camera's-eye view of the street scene is sent to a TV projector that enlarges the scene to life-size and displays it on the screen in front of the driver.

Precision potentiometers, translate the position of the accelerator, brake and clutch into varying voltage signals that are fed to the analog computers. Microswitches indicate the positions of the gear-shift. Rotary switches also are used on the brake and accelerator pedals to indicate light, medium or heavy braking or acceleration. The accelerator is instrumented because, in a crisis, some people step on it instead of the brake. Another potentiometer is mounted on the end of the steering wheel shaft.

The computers were designed and built by Goodyear. One is programmed to reproduce any portion of the automobile engine's performance curve, based on the Plymouth's horsepower and torque characteristics. Accelerator data is fed to this computer to calculate speed data; this is fed to the second computer together with brake, clutch and gear-shift signals. These yield acceleration and deceleration data. The resulting signals are then fed to servomotors that move an overhead bridge on which the vidicon camera is transported over the model terrain.

The system's response time to the driver's actions is limited only by the servomotor's response times, calculated in milliseconds.

Besides feeding speed data to its computer colleague, the engine-dynamics computer also sends signals back to the test car to simulate the effects of an engine in operation. The signals operate the speedometer and a transistorised generator that makes sounds like a car engine. "Leave off the sound," says Poticny, "and the test driver becomes confused."

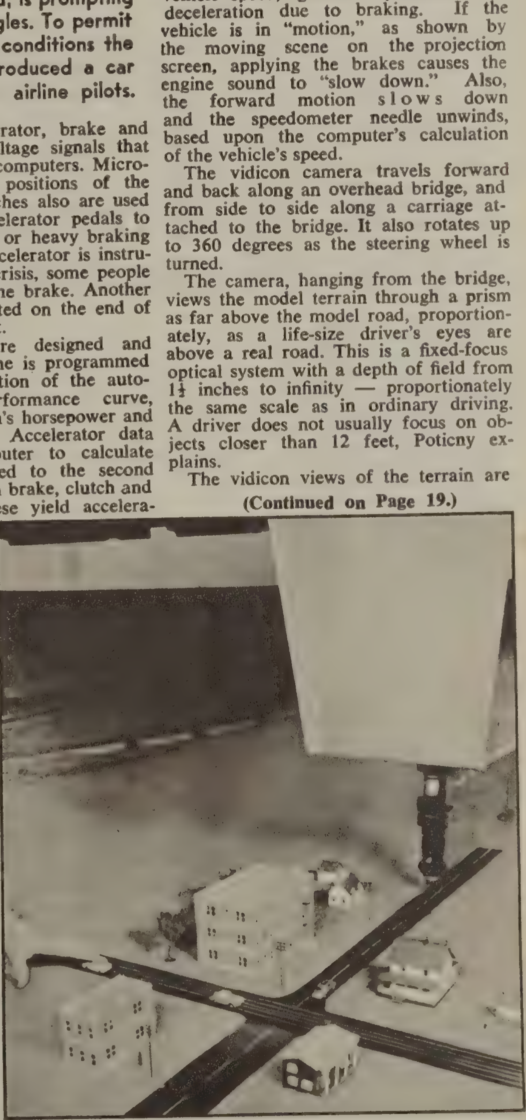
The sound generator also responds to engine torque, vehicle speed, gearshift positions, and deceleration due to braking. If the vehicle is in "motion," as shown by the moving scene on the projection screen, applying the brakes causes the engine sound to "slow down." Also, the forward motion slows down and the speedometer needle unwinds, based upon the computer's calculation of the vehicle's speed.

The vidicon camera travels forward and back along an overhead bridge, and from side to side along a carriage attached to the bridge. It also rotates up to 360 degrees as the steering wheel is turned.

The camera, hanging from the bridge, views the model terrain through a prism as far above the model road, proportionately, as a life-size driver's eyes are above a real road. This is a fixed-focus optical system with a depth of field from 1¼ inches to infinity — proportionately the same scale as in ordinary driving. A driver does not usually focus on objects closer than 12 feet, Poticny explains.

The vidicon views of the terrain are

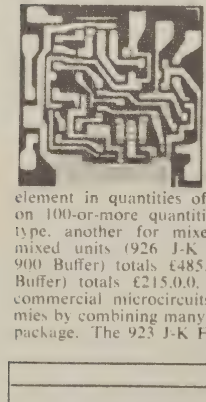
(Continued on Page 19.)



Part of the model street layout with the TV camera on the right. Mounted vertically, it sees the street scene via a prism at the same scale height as the driver's eyes.

ANNOUNCING LOW PRICE MICROCIRCUITS

Fairchild introduces integrated circuits for commercial and industrial applications — priced as low as 43/-!



Low cost. These integrated microcircuits are available from Fairchild at prices meeting the requirements for commercial and industrial use. Functional equivalents of Fairchild's Micrologic and Milliwatt Micrologic elements, they are guaranteed from 15° C. to 55° C. and are available in volume quantities. Prices start as low as 43/- for a 3-input gate element in quantities of 100 or more. There are two prices on 100-or-more quantities, one for orders of a single device type, another for mixed types. Sample: an order of 150 mixed units (926 J-K Flip Flop, 915 Dual 3-input Gate 900 Buffer) totals £485.0.0; for 100 unmixed units (the 500 Buffer) totals £215.0.0. In addition to low price, Fairchild commercial microcircuits offer production and testing economies by combining many components in a single, easy-to-handle package. The 923 J-K Flip-Flop (illustrated) has 15 transistors and 17 resistors in a single monolithic chip. The units are packaged in a low silhouette TO-5 type header with eight or ten leads.

Broad applications. Because of their low-cost and availability, these Fairchild devices open a whole new range of non-military applications for integrated circuits. These include commercial computers, industrial control equipment, instrumentation and test equipment. Fairchild has already used these units in a line of semi-conductor test equipment that has been on the market since 1964.

Proven quality. The Fairchild commercial microcircuit line has grown from the industry's oldest and largest integrated circuit capability. Fairchild started producing Micrologic in 1960 and has produced more than 1,000,000 units, primarily for space and defence. Commercial units are manufactured by the same Planar Epitaxial techniques and benefit equally from Fairchild's long experience and rigid production control.

Comprehensive data sheet available on request.

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FC 3

AUTOMATIC TICKET VENDING AND CANCELLING SYSTEM

While automatic ticket dispensing has been used by transport authorities for many years, it is only recently that this idea has been taken to the next logical stage—where the ticket is automatically checked, endorsed, and cancelled at some point during the passenger's journey. Successful development of the idea could save transport authorities a lot of money.

MANCHESTER (England) Corporation Transport Department has recently introduced the world's first electronic ticket-recognition passenger control system for public transport. The equipment was designed and made in Britain by Ticket Equipment Ltd., of Cirencester, who have also gained an order for a similar application in Frankfurt-on-Main, Germany.

The Manchester system has been introduced on a limited-stop route between Didsbury and the city itself. The equipment makes it possible to operate one-man bus services.

Mr A. F. Neal, general manager of the Transport Department, says that such services will compare favourably with those given by the best two-man type of double-deck bus, while enabling better frequencies to be maintained.

The history of Ticket Equipment Ltd goes back to 1931. During 1964 a large minority shareholding in the company was acquired by Plessey, who now undertake the bulk of their manufacturing.

The system being adopted in Manchester and Frankfurt is based on the Holstimatic electronic ticket - cancelling machine. This is used with the company's existing Unimat automatic ticket issuing equipment.

Tickets are purchased from Unimats installed at the terminus and at intermediate points. The ticket carries a metallic spot at the end. On entering the bus, the passenger inserts the end of the ticket bearing the metallic spot into a Holstimatic machine installed near the driver. The spot is read electronically, and the end of the ticket is cut off by an automatic guillotine. This part of the ticket, which includes the spot, is retained for later checking.

The driver is alerted by a warning device if a ticket is inserted the wrong way up, if it has already been used and the spot cut off, or if any other piece of card is used. Passengers who board without pre-purchased tickets are issued with conventional tickets from a driver-operated machine.

At the same time that the metallic spot is checked, the ticket is stamped with information such as route number, date, time and fare stage. This makes it impossible for an invalid ticket to pass the scrutiny of travelling inspectors.

In addition to the issuing of single tickets, books of tickets can be sold in advance at a reduced rate. Multi-journey tickets can also be produced with a number of metallic spots, one being guillotined on each journey.

The Frankfurt order was won against keen competition from German, French and Italian manufacturers. Ticket Equipment are also to supply the entire passenger control equipment for Rotterdam's new underground railway system, now being constructed.

The company also expect that their equipment will be used by the whole bus system in Geneva, where it is planned that the change to electronic ticket-cancellation will be made overnight.

Mr W. B. Follows, sales director of Ticket Equipment, stressed that there is no standard equipment for transport operations. The company is working on a number of new developments which will take these methods of passenger control a stage further.

("Electronics Weekly.") ■

A passenger takes a ticket from a Unimat vending machine before boarding a bus. (Photos by courtesy United Kingdom Information Office).

On the bus the ticket is presented to the Holstimatic electronic cancelling machine. It slices off the magnetic code spot and endorses the ticket with the route and trip numbers.

CAR SIMULATOR — Continued

displayed on the screen and on a monitor on the control console. The console also is fitted with jacks to provide for oscillographic recording of data from all five position-sensors.

The supervisor at the console has "radio" contact with the test driver. He can give him instructions to turn at a certain corner, for instance. This allows the supervisor to put the driver into a "hazardous" situation, such as coming upon a car stalled just beyond a corner or one darting out of a side road. When such a hazard occurs, the test car's horns and headlights, connected electrically to collision sensors, blare and flash to create additional confusion. That's when a driver might step on the accelerator instead of the brakes.

To assure the accuracy of the test data, high-quality display of the terrain on the projection screen is necessary. A battery of overhead lamps is used to simulate daylight, overcast or nighttime conditions.

Goodyear also has a follow-on contract to evaluate the simulator's results. The results, if validated, will be used to establish criteria and specifications for a combination city-turnpike simulator, which would add car motions, vibrations and acceleration and deceleration effects to its repertoire of stimuli for the driver. It could also widen the display angle from the present 50 degrees, and simulate longer-distance driving by increasing the size of the terrain model. A 180 degrees viewing angle would give the effect of peripheral vision, an important factor in actual driving.

Other simulators are driver-training types such as the Drivo Trainer developed by the Rockwell Manufacturing Co. The system closest to Goodyear's is one owned by the Liberty Mutual Life Insurance Co. It uses a small terrain model and a light source that reflects the model onto a rear-projection screen.

("Electronics" Vol. 38 No. 2.) ■

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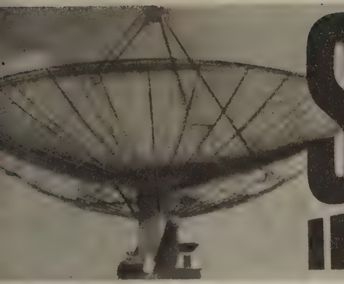


SCIENTIFIC AND INDUSTRIAL NEWS

Silicone Lubricant

An impressive example among the many new uses being found for silicones is an oil additive called lubisil reported on recently in the B.B.C. program "Science And Industry." Motoring correspondent Robin Richards vouched for its remarkable performance, having just driven for over 30 miles at speeds ranging up to 80 miles an hour without oil or oil pressure in a Sunbeam Alpine and found the engine perfectly healthy at the end of it. The secret was that, although the sump was drained before he started his drive, 200 miles before that a dose of lubisil had been added to the Shell X100 oil in the sump and, when the sump was drained, a film of the silicone lubricant remained clinging to the bearing surfaces.

Derek Griffiths, managing director of Silicone Lubrications Limited, the firm that makes this additive, explained that lubisil was what was commonly known as a modified silicone fluid, which should be added to the oil in the very small proportion of 1 per cent for normal motoring, or 2 per cent for arduous conditions. In general, he said, silicones were used in every motor oil today, but purely as anti-foaming agents. Different groups or families of silicones could be combined with oil to produce fantastic results from a lubricating point of view. In his demonstration to Robin Richards the silicones themselves had played quite a large part in lubricating an almost dry engine, and had also combined with the oil to make it effective even when there was only a very fine film of it.

Maser Amplifiers

Mullard Research Laboratories have designed and built a pair of travelling wave masers to amplify signals received at the G.P.O. Earth Station, Goonhilly Down, Cornwall, from Early Bird (HS 303), the world's first commercial synchronous communications satellite.

The new masers incorporate superconducting magnets in place of the much larger permanent magnet of the earlier (1962) device installed at Goonhilly by the Laboratories for the Telstar program. The new masers are believed to be the first in Europe operating with superconducting magnets. The masers operate at the temperature of liquid helium (-271 degrees Centigrade) and are capable of amplifying signals of 10^{-13} watts or even less at a frequency of 4,160MC.

Quarrying By Flame Gun

"A firm which quarries granite in Cornwall has made a saving of £5,000 a year by adopting a new technique for breaking out the rock," reported Denis Desoutter in the B.B.C. 'Science and Industry' program. "Instead of blasting with dynamite, they now do it silently, with the intense heat of a flame gun. This gun burns paraffin (kerosene) and oxygen under pressure, and the heat generated actually melts the stone. When a channel has been melted the block of granite is forced out by wedges. The flame-gun method of quarrying is not only silent, it is much safer than blasting—other men can work nearby without risk—and much less stone is wasted. Other Cornish quarries are now adopting this new process."

Fork Lift Controller

A resistance-free controller designed by a British firm for use in electric fork-lift trucks, is said to offer substantial savings in electricity and to help prolong battery life. The controller also improves performance, allowing operators to manage with smaller and less expensive batteries. Savings can also be made on maintenance costs. Harborough Construction Co. Ltd., Market Harborough, Leicestershire, England. Australian Agents: James Hardie Trading Co. Pty. Ltd., 9-25 Commonwealth Street, Sydney.

Safe, Unsafe Orbits

The high road versus the low road may mean a lot more in space travel than it ever did in Scotland. Space radiation studies by Lockheed—anticipating requirements for the U.S. Air Force's proposed manned laboratory to orbit the earth in 1968—indicate radiation on the "high road" orbit over the poles, in the event of a solar "storm," might be dangerous. But radiation doses will be within safe limits on the "low road" orbit, at angles close to the equator.

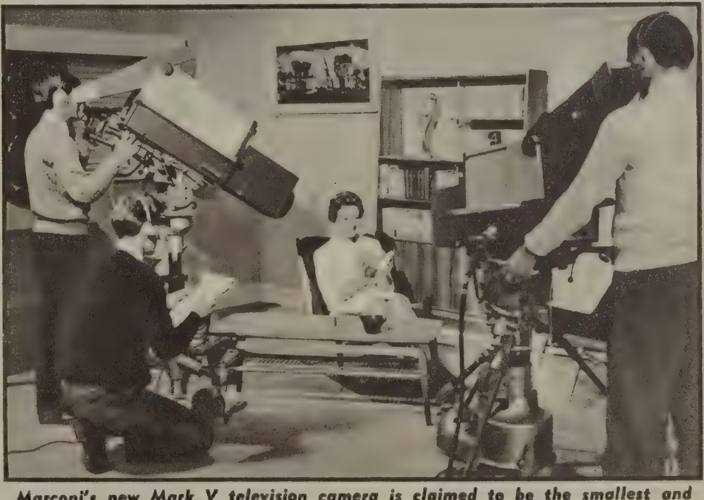
The aerospace company reports that radiation perils will not prohibit successful operation of such a space research vehicle — within the '68 period and in the near-earth, low-inclination orbit proposed. That orbit would be approximately 200 miles high, circling the earth at an angle of 30 degrees to the equator. The U.S.A.F.'s manned orbiting laboratory (MOL) would test man's capabilities in space over a period of 30 days.

For the independent radiation study the Lockheed-California Company drew on data from more than four million photos of the sun, shot since 1958 at its observatory in the Hollywood hills. A continuing research program seeks to understand, and thereby predict, solar flares — apparent source of high energy solar protons that are a major hazard to space travel.

Orbit routes can be important in event of solar activity because many solar particles and cosmic rays are deflected by the earth's magnetic fields—strongest at the equator. Computer techniques developed by the company for the MOL study required less than five minutes to determine radiation through any specific location in the space lab. Computations were made for nearly 1,500 separate areas. This meant handling information on materials ranging from meteoroid "bumpers" outside the vehicle to the human crew inside.

New Miner's Lamp

The Davy Lamp has saved the lives of countless miners since it was invented by the famous British chemist Humphry Davy in 1815. Safe from the point of view of explosions, it is also an effective detector of the miner's terror, methane, which it indicates by showing a characteristic blue glow round the flame. But in a recent broadcast of the B.B.C. program "Science And Industry" Nigel Murphy discussed a possible successor to the Davy lamp with Bill Jamieson, manager of the mining division of



Marconi's new Mark V television camera is claimed to be the smallest and lightest in the world using a 4½-inch image orthicon. Very simple to operate, it has an integrated zoom lens with manual or servo control and a tilting viewfinder which allows the operator to work in more comfortable positions for either low or high camera angles.

SELEX ADEPT

make fine nameplates for fine products

Victa dependability remains constant year in, year out. Victa styling is another feature reflecting the company's pride in its products. Particularly is this expressed in the "Corvette 2" nameplate. Selex-Adept produced it in gleaming silver anodised aluminium foil printed in orange and black. It is self adhesive for quick production line application and to permanently bond to metal. For any type of metal nameplate — heavy or light — leading manufacturers like Victa **rely** on Selex-Adept.

SELEX DECAL PTY. LTD.
(in association with Adept Nameplates Pty. Ltd.)

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SD.246

the English Electric Company, which has spent six years working on it.

Mr Jamieson pointed out that whereas the Davy Lamp only indicated methane above 1¼ per cent in the air (the level at which in British coalmines power must be switched off) this new catalytic detector read the amount of methane in the air down to 0 per cent. It also provided automatically an alarm when the percentage of methane reached a dangerous level. "There are two detectors in the element, one of which has a catalyst and the other has not. The methane burns on the detector with the catalyst and causes its temperature to rise above that of the other. The difference in temperature is measured electrically and indicated on a dial which is a measure of the percentage of methane present. In shape, it is roughly similar to the Davy safety lamp. It weighs about four pounds."

Although designed for coalmines, this new device was useful for detecting any other explosive hydrocarbon gas, Mr Jamieson said. It had been approved for use in factories in connection with the paint group of gases, and would be useful in the paint and petroleum industries and such other places as sewage farms. It would give a true reading of the amount of explosive atmosphere present in stagnant air in about 20 seconds; if the air was moving, in perhaps less than three seconds. The detector is likely to be available on British and overseas markets by the end of 1965.

Better TV Tapes

A signal system modification kit to upgrade the performance of Ampex VR-1000 Videotape television recorders was announced by Ampex Corporation at the National Association of Broadcasters Convention in Washington, D.C. The kit will provide significant improvement in both monochrome and colour capabilities, including bandwidth, signal-to-noise ratio and transient response when incorporated in Ampex VR-1000 "A," "B" and "C" model Videotape recorders.

The company also demonstrated full teleproduction capability of the Ampex VR-2000 recorder, which will produce third generation tapes equal in quality to previous masters. The new high-band recording standard of the VR-2000 extends the upper limits of the video bandwidth to 10 MC, meeting new international standards for colour and monochrome recording and permitting the recorder to produce superior multiple copies of original tapes.

The VR-2000 equipped with Electronic Editor and Editec system, which will permit automatic single frame editing, Intersync television synchroniser, Colortec and Amtec (time element compensator) combine with the new band standard to make the VR-2000 a complete production centre for commercials or feature program material.

Space Research

Following a promise by the Mullard company to contribute £65,000 toward space science research, the Department of Physics, University College, London, is to establish an outstation of the Physics Department specifically devoted to the subject. They have purchased Holmbury House, near Dorking, Surrey, which will be known as the Mullard Space Science Laboratory, and will be headed by Professor Boyd. The other group in the college engaged in space research, led by Dr G. V. Groves, will remain in London.

Scientists at the Mullard Space Science Laboratory will be engaged both on the planning and design of experiments using instruments to be flown in satellites or rockets, and on the subsequent analysis of information received from these flights, together with related laboratory studies. The launchings will be under U.K., American or European auspices.

The main investigations with which they will be concerned are in the fields of ultra-violet and X-ray astronomy both of the sun and of other celestial objects and the study of the ionosphere and the interplanetary medium.

Since the marked success of the team led by Professor Boyd and Dr A. P. Willmore, the deputy head of the new laboratory, with the experiments on the satellite Ariel I, the National Aeronautical and Space Administration in the U.S. has granted facilities for satellite experiments comparable with those given to American universities. The major provision of facilities for sounding rocket flights continues to be made by the Ministry of Aviation and the Woomera Rocket Range in Australia.

During the next four years the European Space Research Organisation will build up to full operation and it is certain that one of the largest users of the facilities provided by E.S.R.O. will be the team at the Mullard Space Science Laboratory.

Totting Up the Doughnuts

A machine that reads pencil marks on report sheets and feeds the facts into a computer, developed by the English Electric Company and the catering and bakery firm of J. Lyons Limited, is simplifying the task of totting up how many doughnuts, Swiss rolls, jam tarts and so on the British public is likely to consume on a given day.

Reporting in the B.B.C. program "Science And Industry," Ray Smithers pointed out that, apart from its chain of tea-shops and restaurants, the Lyons group supplied about 100,000 independent shops and cafes with bakery products. "The daily production of these items must be matched to the combined needs of all these little shops spread across the country. This is where the new reading machine comes in. When one of the company's van drivers delivers a load of bakeries to a village shop he asks the proprietor how many of each cake and bun will be required next time.

"He then ticks the appropriate squares on a prepared sheet

Sensitive Scales

A new British weighing machine is sensitive enough to measure the weight of a fly's wing. All that is necessary is to place the object on a balance pan. The needle then swings over to show the weight in millionths of a gramme. It not only records weight, but can operate as a feedback mechanism to govern the controls further back in a production chain. Combustion Instruments Ltd., Staines, Middlesex, England. Australian Agents: H. B. Selby and Co. Pty. Ltd., 35 York Street, Sydney.

Laser Eraser

The possibility of building a laser eraser into a typewriter has emerged from research work done by Dr A. L. Schlawlow, of Stanford University, Stanford, California, U.S.A. Experimental work showed that it is possible to pulse a laser beam so it will vapourise the ink on paper without affecting the paper itself. The proposed laser eraser would direct the laser beam to the left of the writing position. Touching a button would give a flash of laser energy which would remove the erroneous letter, leaving the space blank to be filled in with the correct one.

Plating Plastics

An electroplating process can produce chrome, gold, copper or bronze finishes on plastic mouldings. The process, which can also be applied to such items as natural leaves for ornamental purposes, is claimed by its developers to be cheaper and speedier than other types of electroplating. Chromeplas Ltd., Albert Drive, Woking, Surrey, England.

Mr John Park, of Felixstowe, England, fits an electric collar to a dog before taking it out for training. Through contacts in the collar, the dog feels an impulse from a transmitter, which he can associate with a wrong move. To use the collar successfully, the trainer must know exactly what he is doing or the dog will be confused.

With his rifle propped alongside, Marine Cpl. David Boyer of Cleveland, Ohio, listens for the sound of enemy movement from his portable "radarscope," on a hillside overlooking an airbase in Vietnam. The radarscope is a newly developed device for spotting enemy movement in the dense brushwood, which covers a great deal of the countryside.

Mullard DECAL

10 PIN VALVES

Further development of the frame grid technique has now made it possible to reduce the electrode diameter to such an extent that a fully separated triode section can be included in the same envelope without impairing the performance of the pentode section. In addition, this new advance has made it possible to develop a frame grid video amplifier, combined with an RF pentode.

DOUBLE-PENTODE 6Y9

The double-pentode EFL200/6Y9 contains dissimilar pentodes with one section designed for video output service and the other an RF amplifier suitable for sync. separator, AGC or sound IF amplifier applications.

TRIODE-PENTODE 6X9

The triode-pentode ECF200/6X9 contains a sharp cut-off pentode section similar to the frame grid valve 6EJ7 vision IF and a triode section with a μ of 55, particularly suited for AGC and noise inverter service.

TRIODE-PENTODE 6U9

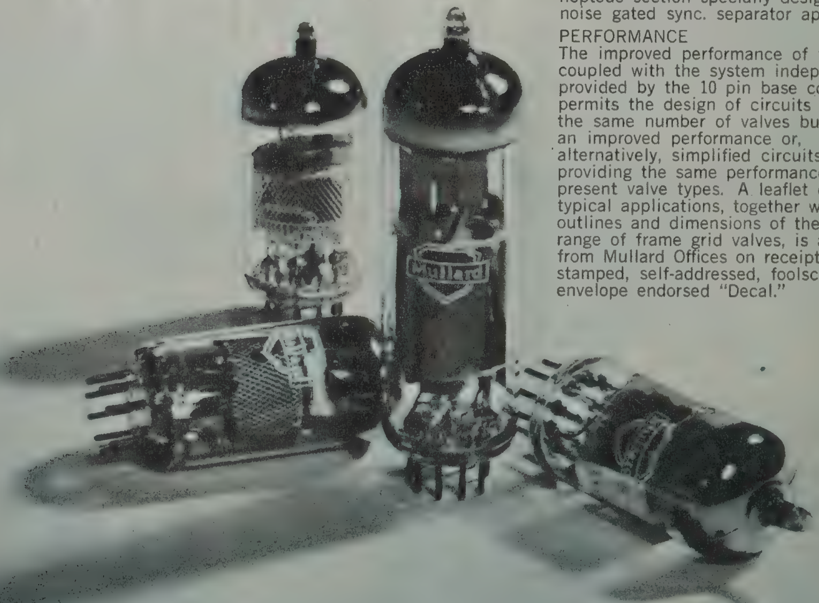
The triode-pentode ECF201/6U9 contains a variable μ pentode section similar to the frame grid valve 6EH7 vision IF and a triode section with a high mutual conductance, specially designed for pulse applications.

TRIODE-HEPTODE 6V9

The triode-heptode ECH200/6V9 has a triode section providing sufficient anode current to drive all conventional phase discriminator circuits and contains a heptode section specially designed for noise gated sync. separator applications.

PERFORMANCE

The improved performance of these valves, coupled with the system independence provided by the 10 pin base configuration, permits the design of circuits utilising the same number of valves but providing an improved performance or, alternatively, simplified circuits providing the same performance as with present valve types. A leaflet detailing typical applications, together with data, outlines and dimensions of the Mullard range of frame grid valves, is available from Mullard Offices on receipt of a stamped, self-addressed, foolscap envelope endorsed "Decal."



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Mullard

M152

-a tick in the three-dozen colum for jam tarts, say. Every day ese reports are sent in to a computing centre, and the computer tals up the nation-wide need for each item in the next 24 ours. It is a system that gives very close control and avoids aste. Furthermore, the development of a machine that can ad the marks directly from the van-drivers' reports cut out the eed to transfer the facts to punched cards or paper tape, and removes one of the biggest bottle-necks in computer productity."

train Monitor

Built-in equipment for the continuous measurement of strains dams, bridges, motorways, and other pre-stressed concrete orks, is one of the latest ideas for saving time and money in roducing accurate information whenever required.

On the new inexpensive system a pre-tensioned steel wire ith an electro-magnetic arrangement for "plucking" it is nbedded into the concrete when moulded. The vibrations of the ire when "plucked" are measured by electrical means and the essage transmitted outside the concrete by a flexible lead. Variaons in the vibrations at intervals indicate the stresses and strains.

Two new products from Ampex: Above is a magnetic-mat recording and reproducing system intended for use in broadcast stations. It incorporates normal cueing facilities and the manufacturers claim that it has advantages in use over the present cassette systems. At right is a new lower-cost portable video recorder, priced at 3,850 dollars and especially suited for use with closed-circuit TV systems. Alternatively, coupled to a domestic television receiver, and possibly a vidicon camera, the unit constitutes a versatile home video entertainment centre.

Temperature measurements are made by means of a pernanently embedded temperature gauge, again with an external ead.

The measuring units are battery-operated portable sets which an be used alone, or with a distant data logging computer. Deakn Phillips Electronics Ltd., Tilly's Lane, High Street, Staines, Middlesex, England. Australian Agents: Richard Foote (Aust.) Pty. Ltd., 63 Hume Street, Crow's Nest, N.S.W.

Protection for Motors

A cheaper and more effective way to protect electric motors s provided by incorporating in the windings positive temperature oefficient resistors recently developed by the Mullard Company, Torrington Place, London, W.C.1, England.

An excessive rise in the temperature of the windings to bove 110 degrees Centigrade or thereabouts will cause a large nd rapid increase in the unit's resistance, thus cutting off the motor's power supply.

Particularly suitable for the protection of remotely controlled motors, the devices are applicable for temperature measurement nd compensation in transistor circuitry and current limiting in the protection of relays used in telecommunication and similar equipment. The resistors are made from doped barium titanate and ive basic types are available, all fitting into a cylinder of 9.2mm. nternal diameter by 11mm. long.

Photocell with Light Source

A photocell which has a miniature lamp sealed inside its metal case near the photo-sensitive surface is being developed as a variable resistor actuated by increasing or decreasing the lamp voltage.

Tiny high-reliability aviation lamps are used and the photocell-lamp units are expected to permit complete isolation of remote control potentiometry, eliminating the need for motor-driven equipment and shielded, in-circuit remote control cables.

They could be used to isolate control circuits from functional circuits in audio feedback and compression circuitry and could simplify wiring in teaching machines. Resistances in the units under development range from about 25 ohms with the enclosed lamps at full brilliance to about one megohm with the lamps off. Both five and 28-volt lamps are under use in the development and either neon or incandescent types can be specified.

General Electric Company of the United States is starting production with a photocell-lamp combination offering a resistance ranging from 40,000 to 160 ohms as lamp voltage is varied from one to five volts. The element is rated at 250 volts maximum with a power dissipation of 100 milliwatts.

Further information is available from International General Electric Company of New York, 296, High Holburn, London, W.C.1, England.

Teaching Films

Schoolteachers are making more and more use of audio-visual aids, notably films with a recorded commentary. But loading a film into a projector usually demands some skill in handling, and a recorded commentary is not always suited to individual needs.

In a recent broadcast of the B.B.C. "New Ideas" program Allan Murray reported on a new range of silent films marketed by the well-known British publishing house of Macmillan for use in conjunction with their textbooks, which avoids both these problems. "Because there is no sound track, the teacher retains the initiative. Guidance notes are supplied with each film, but the teacher makes the points in the way best suited to the needs of the class.

"The films are very easy to show. They are in the form of a continuous loop that needs no re-winding or re-threading. These 'cineloops,' come in plastic casettes, and fitting one into the projector is as easy as changing an electric light bulb. Languages and physics are among the subjects on which films are already available, and others are being added to the range."

Automatic Pyrometer

An accurate pyrometer operates with a narrow band of visible radiation (200 angstroms, centred at about 6,500 angstroms). To eliminate setting errors due to the eye, comparison of the intensity of light of the target and a standard tungsten filament is made using a photomultiplier.

This device is simple to use. Thanks to an auxiliary telescope fitted to the instrument, the operator can sight the target and focus optically. Once the instrument has been set, the measuring button merely has to be turned to obtain the value of the temperature on the large dial of a galvanometer built into the auxiliary electronics box. The instrument can measure temperature with an accuracy of one to two degrees in the range 800 to 200 degrees Centigrade. Manufacturers are Ets Izart et Cie, 27, Av. St. Laurent, Orsay, Seine-et-Oise, France.

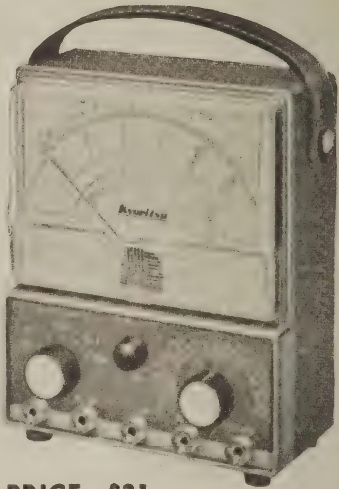
KEW METERS

VOLT-OHM-MILLIAMMETER K-140

The KEW 140 is a smartly styled Multitester which is equipped with an unusual number of ranges—23 in all—covering 5mV to 5000 Volts DC, 0.1 to 5000 volts AC, luA to 10 amps. DC and 0.2 ohms to 20 megohms resistance. The use of printed circuits and solid construction ensures reliability while the clear 6in scale ensures ease of reading.

SPECIFICATIONS

DC Volts: 0-0.25-1-2.5-10 -50-250-1000-5000V.
Input R: 20,000 ohms. Load 50uA F.S.D.
Accuracy: Better than ±3% F.S.D.
DC Current: 0-50uA-1mA-10mA-100mA -500mA-10A.
Accuracy: Better than ±3% F.S.D.
AC Volts: 0-2.5V-10V-50V-250V -1000V-5000V.
Input R: 5000 ohms. Load 200uA F.S.D.
Accuracy: Better than ±4% F.S.D.
Resistance: 0-2K-200K-20megs.
Battery: 7.5V.
Decibels: -20/+10,-8/+22, +6/+36,+20/+50.
Frequency: 10c/s-100Kc (2.5V, 10V and 50V).
Response: Error ±0.5db F.S.D.
Size: 7½" x 6¾" x 4⅛".
Weight: 3.3 pounds.



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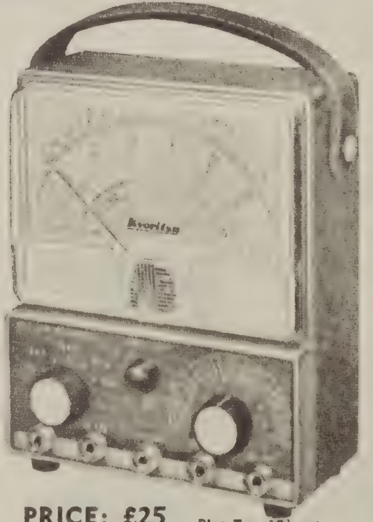

PRICE: £25 Plus Tax 12½ p.c.
FIS Capital Cities all States.

VACUUM TUBE VOLTMETER K-142

The K-142 is a versatile mains-operated VTVM housed in an attractive plastic cabinet with a clear front and a large easy-to-read scale. The K-142 has no fewer than 28 ranges of current, voltage and resistance readings in addition to a db scale.

The weight and size of the K-142 make it ideal for field use as well as laboratory and service work.

SPECIFICATIONS

DC Voltage: 0-1.5-5-15-50 -150-500-1500V (15 or 30 KV Special Probe).
AC Volts: RMS: 0-1.5-5-15-50 -150-500-1500V. Peak-peak: 0-4-14-40-140-400- -1400-4000V
Resistance: 0-1-10-100-1000 Kohms, 0-10-100-1000 Megohms
Accuracy: DCV-3%: ACV-5%: Ohms within 3% total scale length
Decibels: -20 to +65 db
Zero Centre: For adjusting FM detectors
Response: ±3%: -50c/s-500Kc/s: ±5%: -30c/s-1.5Mc/s: ±10%: 15c/s-10Mc/s
Input R: DCV 11 Meg (1 Meg in probe)
Size: 7½" x 6¾" x 4⅛"
Weight: 4.5 lbs.

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RIVERVALE (6-2305)

Crystal Standards

At the Salon International des Composants Electroniques, in Paris, the Marconi Company Ltd., of Chelmsford, Essex, England, exhibited for the first time their large range of crystals within the frequency range 1KC to 80MC. Included in this is a crystal Type Q02130A/F which is a 2500KC Frequency standard which has a frequency adjustment tolerance of ±.0001% at operating temperature and an aging not greater than 5 parts in 10^{10} per day. Marconi's range of oscillators has been increased by four new designs over the past 12 months. Instruments are now available covering the frequency ranges 1-50KC, 4.5-6MC and 14-28MC. A further oscillator has been designed to operate at a nominal frequency of 1MC for counter applications.

Looks Like Marble

A material called Manooga which is claimed to have the feel and solidity of high-quality marble is being manufactured in Australia from powdered stone and a special binding agent.

Outstanding features are said to be resistance to scratches, stains, blows, acids, alkalis and most of the chemicals and agents responsible for damage to marble and ceramic tiles in the average household. Patterns can be created in various colours and the material can be sawn, drilled and filed. Panels can be made up to eight feet by three and a half feet, and in thicknesses of from 3/8in to 1in. It can be polished or left unpolished. The manufacturer is Cement Chemicals (Australia) Pty., of Botany, New South Wales, Australia.

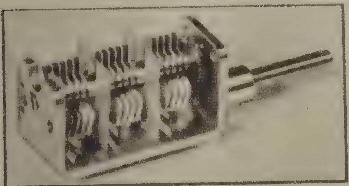
Duck Calling

Latest refinement of high-fidelity recording is a duck-calling system which has a range of three miles and costs 125 dollars from Abercrombie and Fitch of Madison Avenue and 45th Street, New York 17, U.S.A. Played on a marsh at least three miles from any neighbours it is said to attract ducks to the hunter's gun. Calls for various types of ducks are available on records.

Steel-Strong Ceramic

Russia's All-Union Scientific Research Institute of Abrasives and Polishing has created a ceramic material —labelled S-8— which has, it is claimed, a length of service 60 times greater than that of steel and iron, and a wear resistance twice that of hard alloys.

The new material can be easily machined by diamond-tipped instruments to the desired degree of precision. Apertures in the parts are drilled by ultrasonic machine tools. It has been estimated that a ton of the ceramic material will do the work of about 100 tons of steel and 10 tons of hard alloys. S-8 withstands high temperatures and resists intensive abrasive actions.



Parts made of the new material have been successfully tested at engineering plants, at enterprises manufacturing building materials, and at ore-refining plants.

"Improved" Missiles

The U.S. Navy has asked Lockheed Missiles and Space Company to submit a proposal for development and production of the POSEIDON missile system. The POSEIDON missile system, announced by President Johnson in his Defence Message to the Congress, is a new, more powerful, more sophisticated missile to provide POLARIS submarines with greater striking power. Although POSEIDON will have double the payload of the current 2,500-nautical mile A3, it can, with relatively inexpensive minor modifications to existing launcher tubes, be carried by the Navy's fleet of ballistic missile submarines.

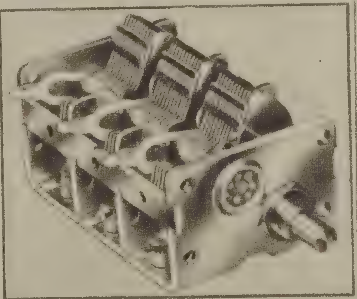
Water Floats On Oil

"Lightweight water" which will float on the surface of burning oil and choke the fire is combined with a powder fire extinguisher in a new double-action fire fighting mixture. The mixture was demonstrated by the Ansul Company at its Marinette, Wisconsin, U.S.A., fire test station. The powder, potassium bi-carbonate, is said to extinguish the fire while the light water covers the fuel and keeps it from re-igniting itself.

The light water is stated to be a fluorinated organic compound developed by the 3M Company. Soluble in water, it foams readily and modifies the water to make it lighter even than petrol. In this form the water floats on the surface of the oil and keeps air from it, preventing re-ignition.

Flip-up Lenses

Welding goggles with flip-up welding lenses are now being sold by Focus Veilig N.V., Postbus 16, Middleburg, Holland. The goggles frame contains two 2-inch diameter plain lenses and there is a second, hinged part containing two dark welding lenses and two plain protective lenses. The flip-up part is connected to the main frame in such a way that no stray light can enter. All lenses can easily be screwed on and off.



Of interest to designers and set builders are these components exhibited at Olympia during May. At left is a variable capacitor intended for VHF and FM applications. At right is its counterpart for broadcast receivers, with inbuilt reduction drive. The dial illustrated is a new dual ratio (6/36) type. (Jackson Bros. (London) Ltd. In Australia, British Merchandising Pty. Ltd., 60 Clarence St., Sydney).

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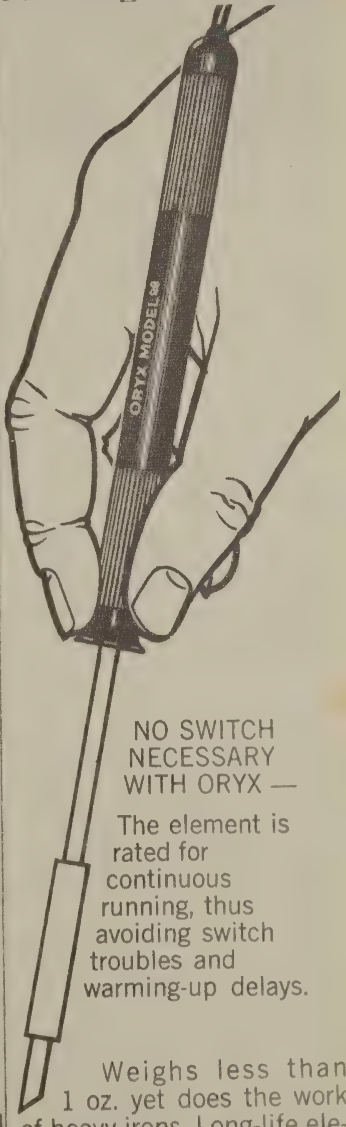

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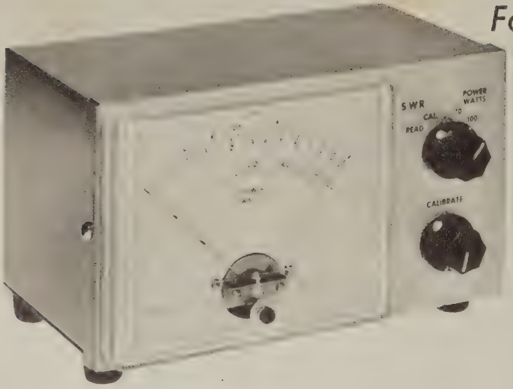


For efficient radiation —

A STANDING WAVE RATIO INDICATOR

By Keith Jeffcoat

Here is a handy little gadget which, inserted in the 50 or 70-ohm coaxial feedline between a transmitter and antenna, will enable the SWR on the line to be read directly. Also, when used with a suitable dummy load, the unit will permit direct power output measurements to be made on a transmitter.

THE need for SWR measurement has become increasingly apparent since the introduction of TV and the general acceptance of SSB by a majority of amateurs. The prevention of TVI (television interference) demands that a proper match be achieved between the transmitter, the feedline and the antenna: again, most SSB transmitters do not take too kindly to a mismatch in their output circuits.

The majority of amateur transmitters in use today have a modified "pi-coupler" type of output circuit which, despite "old wives' tales" to the contrary, do **not** match "anything from a peanut to a piece of wet string."

The truth is that these 50-70 ohm pi-coupled outputs will match only to loads ranging between approximately 30 and 200 ohms and with as small a reactive component as possible. If the antenna and feedline present a load outside this range to the output of the pi-coupler this will be reflected in the form of a mismatch to the plate of the final amplifier valve. Excessive power, in the form of heat, will be dissipated at the anode of the amplifier.

Since these pi-coupled transmitters and, in fact, most amateur transmitting equipment these days, are designed to feed their antenna through a 50 or 70-ohm impedance coaxial cable, the obvious answer is some form of standing wave ratio indicator which can be connected directly in the coaxial feed to the antenna and thus provide an accurate means of matching one to the other.

With the use of a few extra components and a small modification to the circuitry it is possible to make this device do double service as a "wattmeter" for direct measurement of the power output from the transmitter. The advantages of the latter are that it (a) enables us to calculate the efficiency of the final amplifier in the transmitter, and (b) allows the pi-coupler to be adjusted for maximum transfer of energy to the antenna.

A glance at the main circuit diagram will show the simplicity of the instrument.

Basically it consists of a length of 70-ohm coaxial cable from which the outer braided conductor has been stripped. Taped to either side of the insulation surrounding the centre conductor are two equal lengths of enamelled copper wire.

These wires are terminated at one end with a load resistor and their remaining ends are connected to the metering circuit through rectifier diodes.

With a transmitter connected to the "in" terminal of the unit and an aerial connected to the "out" terminal, these short lengths of copper wire will have an alternating current induced in them by the alternating current flow in the transmission line to which they are inductively coupled. They will also develop an AC voltage with respect to earth, due to capacitive coupling.

A fundamental property of coupled lines is that the energy thus induced in the coupled line will always flow in the opposite direction to the energy flow in the inducing line. If the aerial is a perfect match for the line and transmitter, the energy flow in the transmission line will all be in a "forward" direction (from the "in" to the "out" terminal) and the energy induced in the two coupled lines would therefore be in the reverse direction.

Under these conditions the energy in the uppermost coupled lines in the circuit diagram would be absorbed by the terminating resistor (assuming this resistor to be a correct impedance match for the line). There would be zero flow through the 0A91 diode connected to the line and therefore no indication on the metering circuit.

In the case of the lower coupled line on the diagram, however, the energy flow would all take place through the diode and hence through the metering circuit.

If the transmission line is terminated in a mismatch of impedance, some of the energy flowing up the line will not be absorbed or radiated by the load or aerial and will be reflected back down the line to form a "reverse" energy flow.

From previous discussion we can see that this reverse energy flow in the transmission line will cause current flow in the diode circuit of the upper coupled line and no current flow in the lower diode circuit.

In a simple device of this nature it is not possible to measure the exact VSWR (voltage standing wave ratio) or a transmission line, but a very close approximation can be made by comparing the meter reading of the forward energy flow on the line to the reverse energy flow reading.

Supposing, for instance, that the meter is calibrated from 0-10. We switch it to the lower line and, with a fixed power input from the transmitter, adjust the calibrate potentiometer so that the meter reads full scale. If we now switch the meter to the upper line it will read less than full scale since this will be reverse power (energy flow) and we could not have more energy flowing back down the line than originally went up it.

An approximation of the SWR on the line may be obtained from the forward and reverse readings by the use of the following formula:

$$\text{SWR} = \frac{\text{If} + \text{Ir}}{\text{If} - \text{Ir}}$$

Where If is the forward reading and Ir is the reverse reading.

If, in a hypothetical example, we had a reverse current reading of half scale (or 5 on our 0-10 scale) we would, from our formula, have 15 divided by 5 o a SWR of 3 to 1. From this it can be seen that we can easily arrive at the various scale readings which would correspond with SWR's from 1.1 to 1 to infinity.

The scale of our instrument has, in fact, been calibrated in SWR on thi basis and a copy is included in the article for readers who would like to calibrate their meters accordingly. Ready-made and calibrated meters will probably be available from local manufacturers.

It will be noted that we have no shown SWR calibrations for anythin above 5 to 1. In a practical coaxial fed aerial system, a VSWR of about 2.5 to 1 would be the maximum which could be tolerated, so that the measurement of ratios beyond this figures is really onl of academic interest. To give figures beyond 5 to 1 was, we felt, just a waste of time.

The meter movement we used ha a sensitivity of 100 microamps for ful scale deflection. We chose this movemen for three reasons: (a) It allows SWR readings to be made using low power transmitters (with a 1 milliamp movement as much as 35 watts input would be required on some bands).

(b) It allows us to use a fairly high resistance between the diodes and the meter and this helps to maintain the linearity of the readings, particularly where power measurement is involved.

(c) There is only a very few shillings difference between the price of a 100 microamp and a 1 milliamp movement and, for the small price difference involved, one might as well have the additional advantages.

To increase the versatility of the instrument we have added a pair of switches to change the terminating resistance on each of the pickup lines. When checking aerials fed with 50-ohm coaxial cable, the line needs to be terminated with a 270-ohm resistor; for 70-ohm co-ax fed aerials this terminating resistor needs to be 230 ohms. Switching a 1500-ohm resistor in parallel with the 270-ohm unit reduces the total value to 230 ohms and thus allows SWR measurements to be made on either 50 or 70-ohm co-ax fed aerials.

In an instrument of this type, the pick-up line must be terminated with a non-inductive resistor which is equal to the characteristic impedance of the line. In our instrument the pick-up lines, when constructed to the dimensions to be given later in the article, have characteristic impedances equal to the value of the resistors given in the previous paragraph.

The remainder of the SWR circuitry is fairly straight forward and includes a simple switching system to transfer the meter from the top to the bottom pick-up line for forward or reverse power monitoring and a calibrate potentiometer so that the meter can be set for a full scale reading in the forward power position.

The remaining two positions for the function switch bypass the calibrate potentiometer and the pickup lines and connect the meter into a simple and straight forward circuit which reads the RF voltage on the centre conductor of the coaxial line.

The power output (in watts) of a transmitter may be easily determined by terminating the output of the transmitter with a non-inductive resistor of known value and then measuring the RF voltage developed across this resistor. Multiplying the developed voltage by itself and dividing the result by the value of the resistor will give the power output in watts.

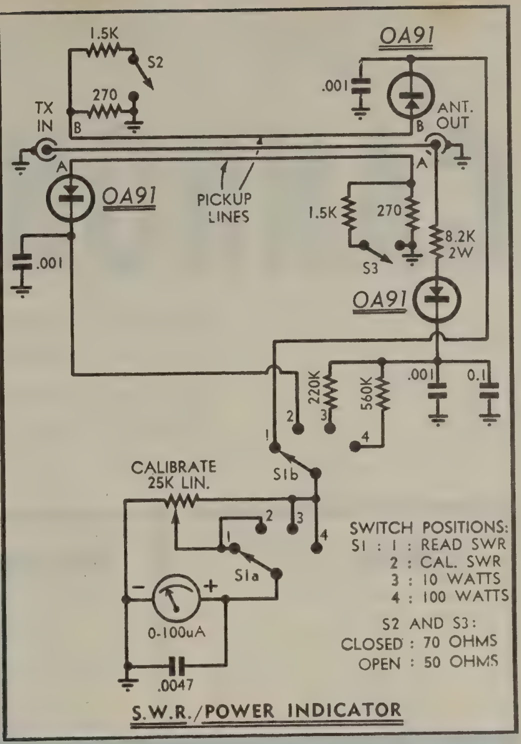
The switched resistances in our simple voltmeter circuit are chosen to agree with the scale readings of 0 to 10 and 10 to 100 watts when the output or "antenna" coax. connection of the unit is terminated by a 70-ohm non-inductive load resistor.

Our unit, in other words, simply reads the voltage across the 70-ohm resistor and then gives a scale reading, in watts, based on the voltage present. Thus a low power transmitter which produces a scale reading of 3 watts is actually producing 14.5 volts across the 70-ohm resistor and it is this voltage which our meter reads.

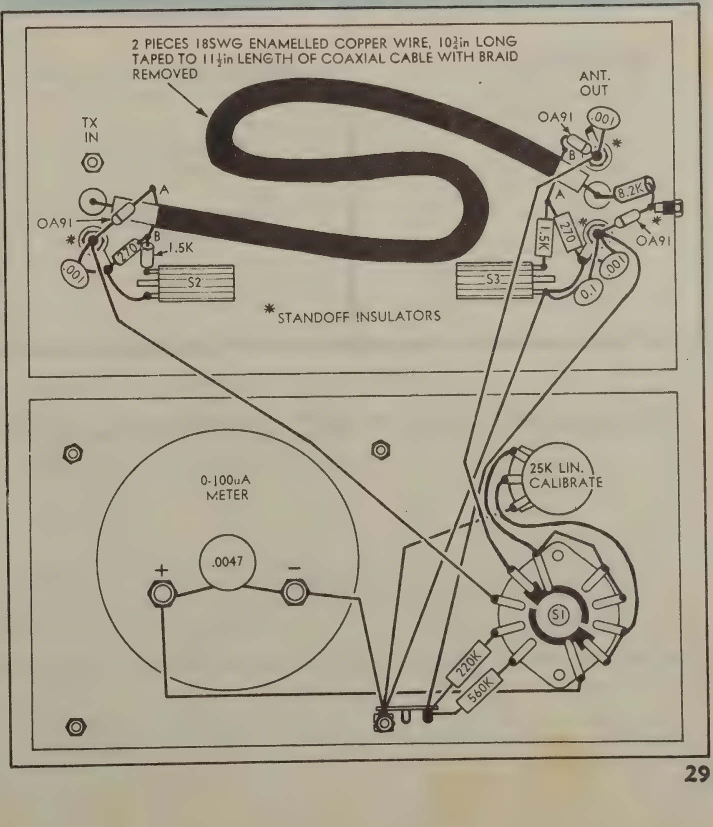
The resistor-capacitor values in our simple "power" meter are chosen to give correct scale readings when used with a transmitter on 14 MC. The readings will be slightly out if used with a transmitter on other bands, as this type of circuit does not have a flat frequency response.

As a check against the calibrations or for those who wish to calibrate the unit for use on another band, we have included some figures which give the voltage developed across the load resistor for power up to 10 watts and the RF current flowing through the load for power between 10 and 100 watts.

If a vacuum tube voltmeter having an accurate RF probe is available, the former could be used to check or calibrate



At right is the circuit of the standing wave ratio indicator, which has the additional in-built facility for measuring the RF power being delivered to a 70-ohm non-inductive resistance load. Shown below is the wiring diagram. The components shown at the top are mounted inside the shallow metal box; those below, inside the removeable lid. The box performs an important shielding function.



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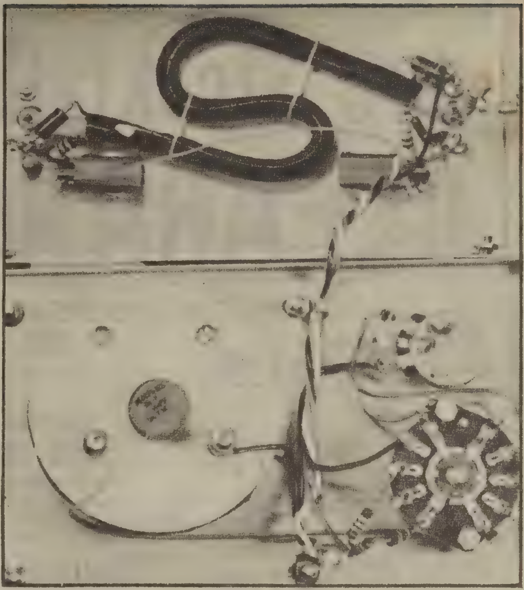
the unit on its 10-watt scale. Since most VTVM's will not read RF volts above 30, an RF ammeter calibrated to at least 1.2 amps could be used in conjunction with the latter set of figures to check or calibrate the 100-watt scale.

Readings with VTVM (plus an RF probe) across a 70-ohm load resistor:

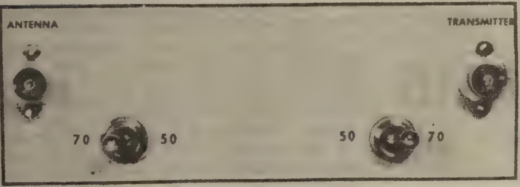
8.35 volts = 1 watt
11.8 " = 2 "
14.5 " = 3 "
16.7 " = 4 "
18.7 " = 5 "
20.5 " = 6 "
22.15 " = 7 "
23.7 " = 8 "
25.1 " = 9 "
26.5 " = 10 "

Readings with an RF ammeter placed in series with a 70-ohm load resistor:

0.5 Amps = 20 watts
0.66 " = 30 "
0.76 " = 40 "
0.84 " = 50 "
0.93 " = 60 "
1.0 " = 70 "
1.07 " = 80 "
1.13 " = 90 "
1.2 " = 100 "



Corresponding to the diagram at the foot of the previous page, this picture shows the inside of the completed SWR/Power Output indicator. Make sure that the S-shaped piece of line does not buckle against the metal panel and thereby unbalance the impedance of the two pickup lines. Below is a rear view of the unit, showing the input and output connectors and the switches which allow the impedance to be changed.



Our SWR/power meter is housed in a standard instrument case measuring 7 by 4 by 4 inches and uses a meter having a case front size of approximately 4 by 4½ inches. We could, perhaps, have used a smaller case and meter movement but we would not have saved any money by doing so and would have only made it more difficult to read the meter. The larger case also has the advantage of being more stable when placed atop a transmitter, the position it will normally occupy.

To simplify the wiring and construction of the unit, we have included a layout and wiring diagram in the article. From this diagram it will be noted that the diodes on each of the pickup lines are terminated on a ceramic stand-off insulator and then bypassed to ground by 1000pF capacitors.

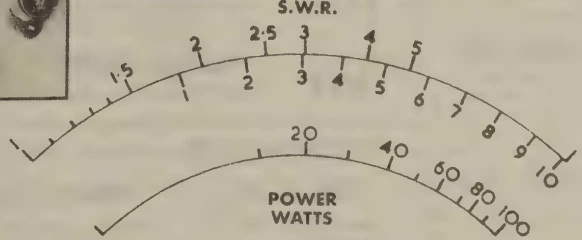
If the unit is to work as it should, it is most important that the leads of the diodes and their bypass capacitors should be made as short as possible, remembering, of course, to hold the leads of the diodes with a pair of long-nosed pliers when soldering them to prevent heat damage.

Similarly, the leads of the 270 and 1,500-ohm resistors should be kept to a minimum of length as should the leads from the two impedance switches. In our prototype unit we used ordinary toggle switches to short the 1,500-ohm resistor to ground but the small "slider" type switches which are commonly available could just as easily be used.

When purchasing the components for the unit, make sure that all resistors are of the carbon composition type and not wire-wound and that the 1,000pF capacitors are of the "disc ceramic" type.

The "heart" of our instrument is the section of coax. inner conductor (plus its dielectric) with parallel pickup lines. In our unit we used an 11½in length of RG-8/U coax. (minus its outer braid) for this section and, unless the reader wants to go to the trouble of working out new values for the terminating resistors, we suggest that the same length and type of coax. be used.

The particular type of coax. may be identified from the following details: Nominal overall diameter, 0.405in; nominal diameter of dielectric, 0.285in; inner conductor, 7 strands of 21 SWG copper wire; nominal impedance, 52 ohms.



The meter scale for the instrument shown here approximately full size.

INTERNATIONAL CONFERENCE

An important international scientific conference will be held in Melbourne University, 16-21 August. The twin themes of the Conference will be "Electron Diffraction" and "Defects in Crystals." The Conference will be under the joint sponsorship of the Australian Academy of Science, the International Union Crystallography, and the International Union of Pure and Applied Physics.

Chairman of the organising committee, Dr R. I. Garrod, has stated that about 200 prominent physicists, chemists, metallurgists and geologists would be coming from the U.K., U.S.A., Japan, U.S.S.R., Spain, India and Brazil. About an equal number of Australians would also attend.

President of the Conference will be Professor Dame Kathleen Lonsdale, F.R.S., Professor of Crystallography in University College, London. Among the delegates will be Professor L. H. Germer, whose early experiments with Dr C. Davidson led to the discovery of electron diffraction, Professor P. P. Ewald, whose work set the foundations of a theoretical understanding of diffraction in crystals, and Professor Fredderick Sietz, President of the American Academy of Sciences.

Dr Garrod said that this type of conference was held about every two years on various topics in different parts of the world, in centres of vigorous research into the topics to be discussed. "It was a tribute to the work going on in Australian laboratories in electron diffraction and defects in crystals that the Conference had been allocated to Melbourne by the international bodies."

The pickup wires are each 10¾in long and are constructed from 18 SWG enamelled copper or tinned copper wire — whichever is available. These wires should be stretched so that they are straight and then taped, diametrically opposite, to the outside of the dielectric around the coax. inner conductor.

Be sure to tape these pickup wires tightly to the full length of the coax. piece since the finished line must be bent into the form of an "S" in order to fit its length into the case. Unless they are tightly taped the wires will distort away from the coax. and affect the performance of the finished unit.

When formed into an "S" shape the coax. is rather springy and somewhat hard to hold while it is being soldered to the terminals of the coax. sockets at the rear of the case so, to aid in this process, we suggest tying a piece of string around both loops of the "S".

The remainder of the wiring is quite straightforward and should be self-explanatory from the wiring diagram.

Upon completion of the unit, and before placing it in service, it is a good idea to check the pickup lines and their terminating resistors for symmetry. To do this, a 50- or 70-ohm non-inductive dummy load resistor should be connected to the antenna connecter of the unit and the transmitter connected to the input connector. Turn the function switch to "100 watts," switch on the transmitter and adjust its output tuning for a maximum meter reading.

Now turn the function switch to

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"Cal." (calibrate) and use the calibrate control to set the meter for full-scale deflection. Turn the function switch to "read" and note the reading on the SWR scale. If the unit has been constructed to specifications it should be very close to zero on the scale.

Next, reverse the input and antenna connections and, with the function switch still in the "read" position, turn on the transmitter and once again adjust the calibrate control for a full-scale reading. Now turn to the "cal." position and note the reading. It should be near zero or, at the very least, exactly the same as was obtained in the "read" position on the previous test.

If there is a difference in the two readings it will be necessary to modify the value of the terminating resistor on the "read" pickup line until the two readings agree. Strictly speaking, in fact, the value of the terminating resistors on both lines should be adjusted to make the meter read zero in both of the tests described.

The latter is important if the SWR scale is to mean something. If the reader intends to use the device only as a rough indication of antenna matching, the tests described could be omitted.

When using the unit to check out an antenna system remember that improvements or otherwise in the SWR on the line can only be effected by adjustments made AT THE ANTENNA. Adjustments to the output coupling and tuning of the transmitter will affect the power actually fed to the line and antenna but can have no effect on the SWR of the line.

When making adjustments on an antenna for SWR, the best place to put the meter is in the line close to the antenna, particularly when working on a VHF antenna.

The reason for this is that power reflected back down the line by a mismatch is dissipated in the form of heating of the dielectric of the line and, with a VHF antenna fed by a long length of coax. line, a low SWR reading may be obtained with the meter in the line at the transmitter, whereas the true SWR may actually be quite high.

In closing this article we might mention a couple of "traps for young players" which can occur with SWR devices of this kind. The first concerns the unit's potential as a producer of TVI!

Our SWR meter uses diodes to rectify the RF current on the pickup lines and it must be remembered that diodes, being essentially non-linear devices, will be generating harmonics at the same time as they pass rectified current and that these harmonics are potential sources of TVI. For this reason, the unit should NOT be constructed on an open chassis but should be in a totally enclosed metal box. If you do experience trouble with TVI, remove the unit from the line before tearing the transmitter to pieces. It may be the source of your trouble.

The second trap concerns a condition where, properly connected between a transmitter and an antenna, the meter will show a higher reading in the "read" position than it does in the "cal." position. Since this would indicate that there is more power flowing back from the antenna than originally went up to it (an obvious impossibility) there must be something amiss.

The cause of such a condition is parasitics (usually in the VHF region) in the output or driver stage of the transmitter. ■

HORIZONTAL DEFLECTION VALVES AS RF POWER AMPLIFIERS

By W. D. Murphy

Television horizontal amplifier valves would appear to have attractive possibilities as RF power amplifiers in Amateur transmitters but, unfortunately, data for RF service are seldom given. This paper, reprinted from "Sylvania News" will give some guidance as to how operating conditions for RF service are derived.

THE limited choice of RF power amplifier valve types in the 50-watt category and their relatively high cost has caused designers of amateur and industrial communications gear to seek out acceptable commercial receiving valves for use in this field.

Modern horizontal deflection amplifier valves, while not originally designed for RF applications have several attractive characteristics: (1) They are capable of high peak currents, an important factor in single sideband applications; (2) these high currents are attainable at low plate voltages which can result in power supply economy; (3) Widespread usage in television applications contributes to low cost and general availability.

Since deflection valves are designed and controlled in manufacture only for deflection amplifier service, manufacturers ordinarily do not publish data specifically showing operating conditions or capabilities in the various types of RF service.

In the interest of providing guidance for the equipment designer, Sylvania's engineering laboratory has measured and tabulated actual performance of several valve types operating in both Class AB1 and Class C at a frequency of 30MC.

Deflection valves can be divided into two general categories, those designed for black-and-white television, and having a plate dissipation rating of about 17 watts and larger 25-30 watt valves designed for colour applications. Variations occur in basing, internal connections, and certain electrical characteristics to satisfy specific application requirements.

Four types of low power B and W valves and two colour TV types which appeared suitable for RF service were selected for evaluation:

B&W—6GJ5—6JB6—6JM6—6JG6
Colour—6HF5—6JE6

The types 6JB6 and 6GJ5 differ only in that the former has separate pin connections for the beam forming plates, while in the 6GJ5 the beam plates are internally connected to the cathode. Both have 9-pin novar bases. The Type 6JM6 has a 12-pin base, and slightly lower peak current capabilities than the other types. The Type 6JG6 is a single ended tube designed specifically for "Low B+" television applications.

The Type 6JE6 and 6HF5 have plate dissipations of 24 and 28 watts respectively in colour TV deflection service. The 6JE6 has a 9-pin novar base and the 6HF5 a 12-pin base.

The performance, operating conditions, and power levels are shown in Tables I and II. The Class AB1 operation is particularly applicable to single sideband linear amplifier service, while Class C operation applies to CW and narrow-band FM operation.

VALVE RATINGS: The plate dissipation rating of a particular valve type is established only after extensive life testing, and is set at a value which will result in long life, and no damage to the valve. Deflection valves are rated for continuous duty, and therefore must be capable of operating continuously at established dissipation levels.

Intermittent operation, such as might be encountered in two-way communication equipment, allows one to operate

TABLE III—Upper Frequency Limit

Type	C Input (pf)	Input Resonant Frequency (MC)	C Output (pf)	Output Resonant Frequency (MC)	Probable *** Upper Frequency Limit of Operation (MC)
6GJ5	19.1	190	10.0	190	150
6HF5*	25.5	86	16.3	141	60
6HF5**	26.7	100	16.3	141	75
6JB6	19.1	190	10.5	200	145
6JE6	24.3	82	14.5	152	60
6JM6	17.2	200	10.3	194	150
6JG6	22.9	187	14.7	226	150

*One Grid Connection
**Two Grid Connections
***75% of Self-Resonant Frequency

TABLE I—Class C Operation, ICAS 30MC

Type	(1) Ecc1 Vdc	(1) Ecc2 Vdc	(1) Ebb Vdc	Peak Ec1 V RF	(1) Ic1 Ma dc	Ic2 Ma dc	Ib Ma dc	Grid 1 Driving Power (Approxi.) Watts	Grid 2 Dissipation Watts	Plate Input Power Watts	Power Output Watts RF	Efficiency %	Plate Dissipation Watts	(2) Circuit Loss Watts
6GJ5	–75	200	500	61	5.0	14.9	180	.43	2.99	90.0	62.7	69.5	22.0	5.3
6HF5	–85	140	500	67	8.0	12.5	232	.76	1.75	116.0	77.0	66.0	35.0	4.0
6JB6	–75	200	500	61	5.0	13.3	180	.43	2.66	90.0	62.7	69.5	22.0	5.3
6JE6	–85	125	500	72	8.0	17.2	222	.82	2.15	111.0	76.3	69.0	30.0	4.7
6JM6	–75	200	500	57	4.0	13.7	180	.32	2.72	90.0	61.1	67.9	22.0	6.9
6JG6	–80	150	450	67	8.0	20.0	202	.75	3.0	91.0	63.0	69.3	21.0	7.0

(1) Selected as Optimum Operating Conditions as Outlined in Text.
(2) Calculated Power Lost in Tank Circuit.

TABLE II—Class ABI Operation, ICAS 30MC

Type	(1) Ecc1 Vdc	(2) Ecc2 Vdc	(2) Ebb Vdc	(1) Ib 0 Signal Ma dc	Ic2 Ma dc	Ib Ma dc	Plate Power 0 Signal Watts	Grid 2 Dissipation Watts	Plate Input Power Watts	Power Output RF Watts	Peak Envelope Power (P.E.P.) Watts	Efficiency %	Plate Dissipation Watts	(3) Circuit Loss Watts
6GJ5	–43	200	500	30	3.8	85	15	.76	42.5	17.5	35.0	41.5	22.0	3.0
6HF5	–46	140	500	40	4.5	133	20	.63	66.5	28.8	57.6	43.0	35.0	2.7
6JB6	–42	200	500	30	4.2	85	15	.84	42.5	17.5	35.0	41.5	22.0	3.0
6JE6	–44	125	500	40	3.9	110	20	.49	55.0	23.4	46.8	42.6	30.0	2.6
6JM6	–42	200	500	30	4.4	85	15	.88	42.5	18.3	36.6	43.1	22.0	2.2
6JG6	–35	150	450	30	4.5	98	13.5	.67	44.0	18.9	37.8	43.0	21.0	4.1

(1) Ec1 Adjusted to Indicated Ib (Zero Signal).
(2) Optimum Conditions for Providing Best Linearity and Efficiency.
(3) Calculated Power Loss in Tank Circuit.

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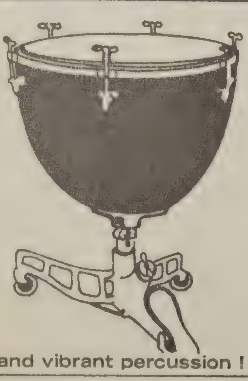

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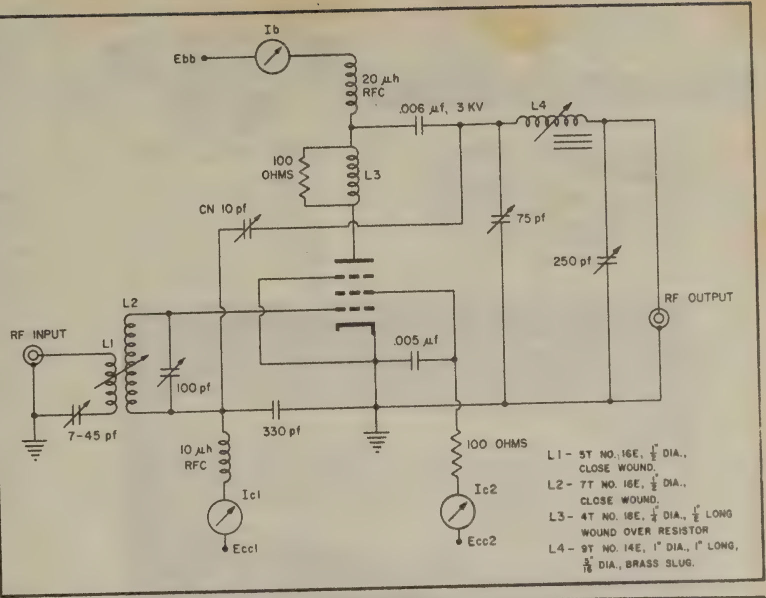
a valve at higher power than would be permissible on a continuous basis.

For this type of service, many transmitting valves carry Intermittent Commercial and Amateur Service ratings, as well as Continual Service ratings, the ICAS plate dissipation rating is 25 per cent higher than the CCS rating of the same valves. The same 25 per cent increase over the published values was used to establish the maximum plate dissipation for the several deflection valves evaluated at 30MC.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Ebb
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.006 µf, 3 KV
L4
100 OHMS
L3
CN 10 pf
75 pf
250 pf
L2
RF OUTPUT
RF INPUT
L1
100 pf
.005 µf
7-45 pf
330 pf
10 µh RFC
100 OHMS
Ic1
Ic2
Ecc1
Ecc2
L1 - 5T NO. 16E, ½" DIA., CLOSE WOUND.
L2 - 7T NO. 16E, ½" DIA., CLOSE WOUND.
L3 - 4T NO. 18E, ¼" DIA., ½" LONG WOUND OVER RESISTOR
L4 - 9T NO. 14E, 1" DIA., 1" LONG, 5/16" DIA., BRASS SLUG.

Figure 1: The circuit used for testing RF performance at 30MC.

MEASUREMENTS: To measure a particular valve's capabilities, several amplifiers were constructed for the various valve types with circuitry similar to that found in high frequency transmitters. Figure 1 shows the typical 30MC test circuit. Pi network output circuits allowed considerable adjustment of the tuning, loading and circuit "Q." All supply voltages were adjustable to permit determination of optimum operating figures.

Figures 2 and 3 show the complete test set-up. Grid drive was obtained from a commercial sideband exciter. CW input at 30MC was required for Class C studies, while Class AB1 operation utilised a "two-tone" input. The "two-tone" signal varies from Zero to its maximum value at about 1,000 times per second, and tests the Class AB1 linear amplifier over its entire operating range. Observation of the output with a wideband oscilloscope provides an accurate indication of linearity.

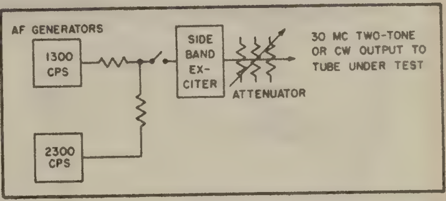

Figure 2: The driver set-up to obtain two-tone signal for AB1 linear operation or CW for class C operation.

The point at which power output no longer increases linearly with increasing grid drive is determined by a valve's basic design. Driving the valve beyond this point results in "flat-topping" and distortion. The maximum undistorted output is referred to as Peak Envelope Power, or P.E.P., and is a measure of a particular valve's capability as a linear amplifier.

Linerity is of utmost importance in single sideband applications. Any non-linearity represents distortion which produces spurious signals that result in excessive bandwidth.

Class C operation was established at the condition of minimum grid drive necessary to provide plate saturation and best overall efficiency.

Following is a summary of conditions under which the valves were operated:

(a) I.C.A.S. maximum plate dissipation capabilities for Class C and A.B.1 linear service were established at 1.25 times the rated plate dissipation for deflection service.

(b) I.C.A.S. maximum screen dissipation limitations for all types were kept identical to the rated screen dissipation for deflection service.

(c) Class C operating conditions were established at the point where conditions in (a) and (b) were not exceeded. In general, maximum plate dissipation was the limiting factor.

(d) Class AB1 operating conditions were established at the point where the two-tone signal did not exceed the predetermined I.C.A.S. suggested ratings in (a) and (b); linarity and efficiency were optimised. The wave shape of the two-tone input signal was monitored to insure that no "flat-topping" occurred during Class AB1 operation.

(e) Various combinations of plate, screen, and grid bias voltages as well as grid drive, plate current, tank circuit "Q" loading, etc., were used to determine an optimum operating condition consistent with the suggested I.C.A.S. plate and screen dissipations.

Power output was determined with a calorimetric wattmeter, which operates on the principle of measuring the temperature rise in an R.F. load resistance.

Plate dissipation for each valve was accurately measured by use of recently developed laboratory type infrared temperature measuring equipment. Any object gives off infrared radiation whose intensity varies in proportion to the temperature.

The measuring equipment consists of an optical system for focusing the infrared radiation on a suitable detector, an amplifier, and indicator system. The optics are designed so that only a small area is observed. If for example, a valve plate is observed, the detector will indirectly show the power being dissipated by the plate.

Accurate determination of infra-red detector reading vs. power can be made by actually "calibrating" the valve under test. A known plate voltage and current are applied to the valve, with no drive or load, and a curve of temperature reading vs. D.C. power to the plate is plotted. Then, with the valve operating normally in its test circuit, plate temperature becomes a precise measure of plate dissipation within the valve.

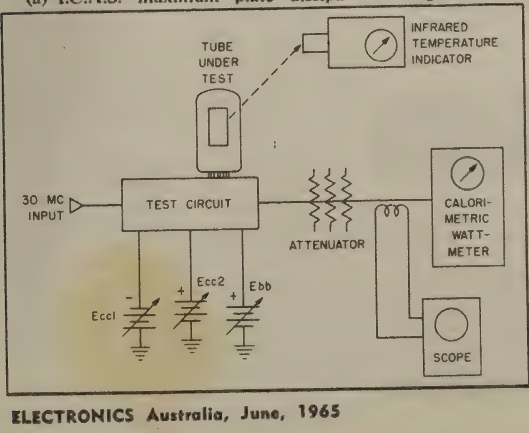

Figure 3: Test set-up for measuring power output, plate dissipation and checking linearity of the valve under test.

FREQUENCY LIMITATIONS: The

(Continued overleaf)

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physical construction of a valve is important in determining its high frequency performance. Since horizontal deflection circuits operate at a low frequency, considerations which determine valve lead length, interelectrode capacitance, basing, etc., are not the same as for high frequency valves. These factors place a limit on high frequency performance.

A high output capacitance, for example, would shunt the RF plate current to ground, resulting in excessive currents within the valve. The same is true of the input circuits. Lead inductance resonates with the valve capacitance at some high frequency, further increasing stray currents.

A comparative evaluation of valves was obtained by measuring resonant frequencies, input and output capacitance. This is shown in Table III. The effect of lead inductance is evident from the Type 6HF5 input circuit measurements. With only one grid connection, the valve was resonant at 86MC. With both grid leads connected in parallel, capacitance increased, but the resonant frequency also increased to 100MC.

In conclusion, it should be kept in mind that the operating conditions and limiting values presented in this article are only suggested. They do not constitute formal ratings such as those established for the various valve types in their intended application of horizontal deflection amplifier.

EDITOR'S NOTE: Horizontal deflection amplifier valves are normally tested during manufacture to ensure that they will perform in the standardised manner for the particular type in the particular class of service. Constructional differences between valves of different manufacture, while not affecting their behaviour in the intended application, may affect their behaviour in a class of service for which they are not specifically designed or tested.

Thus, the data derived here for Sylvania valves will not necessarily apply in all details to valves of other manufacture, though it should serve as a useful guide.

It should also be noted that the glass-based types listed are not very common in Australia, most deflection amplifier valves in this country using conventional moulded bases. This would probably impose some additinal restriction on upper frequency limit.

Other than this, the Australian type 6DQ5 has ratings which are virtually identical with those of the 6JE6, evaluated in the article. The Australian type 6DQ6B likewise has ratings which are virtually identical to types 6JB6A and 6GJ5.

Locally available types which are well worth considering for RF service include also the 6CD6G, 6CN6, 6BG6G and 6CB5A. Of these only the 6CD6G is on the list of "preferred" types in the commercial sense. ■

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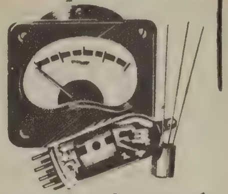
Basic Radio Course



CHAPTER 22:

Following last month's chapter on practical set construction, we are presenting a similar chapter this month. However, whereas last month's circuits were intended for use with components salvaged from old sets, this month's project is a new design using all new parts.

FROM the earliest days of radio, the majority of enthusiasts seem to have "cut their technical teeth" on small regenerative receivers, progressing later to bigger things. The transistor receiver described here is in true tradition, as far as general form is concerned, but the transistors and their associated circuitry can provide an effective introduction to modern techniques.

Strictly speaking, the term "regenerative" receiver can be regarded as applicable to any receiver employing the principal of regeneration (or positive feedback) anywhere in its circuitry.

However, as you will have come to appreciate, if you have followed our Basic Radio Course, it is usually taken to describe a receiver in which the detector, for maximum gain and selectivity, relies on the use of regeneration, reaction, or positive feedback. In this context, all three terms mean much the same thing.

The simplest regenerative receiver would be one using only a detector feeding, probably, a pair of headphones. Larger regenerative sets incorporate one or more stages of audio amplification after the detector and/or, less frequently, a stage of RF amplification ahead of the detector. (If further explanation is required, we would refer you, once again, to Chapter 10 of the Basic Radio Course.)

Over the years, we have described many regenerative receivers in this journal, details of some being available still through the Information Service.

Of these, circuits using battery-powered valves can be regarded as truly obsolete. Battery-type valves were never distinguished for reliability, performance or economy so that, by and large, even if you have some of these valves on hand, it is probably cheaper not to use them!

The money you might spend on batteries to power them would be better put towards buying transistors.

Regenerative receivers using mains-operated valves are in a different class, if only because they can often be built with a minimum of outlay, and with good experience, using parts salvaged from discarded receivers. That is why we presented a selection of such circuits last month.

For those who may prefer to use new parts, it is very hard to go past the kind of transistor receiver described here, with the distinct advantage that no high voltages are present, to make contact with, accidentally.

Unfortunately, we cannot pretend that building a receiver like this, using all new parts, is a very economical proposition. If the purpose is primarily to acquire a receiver to "follow the hits," it is hard to compete with the cheaper transistor sets which are so plentiful just now on the local market.

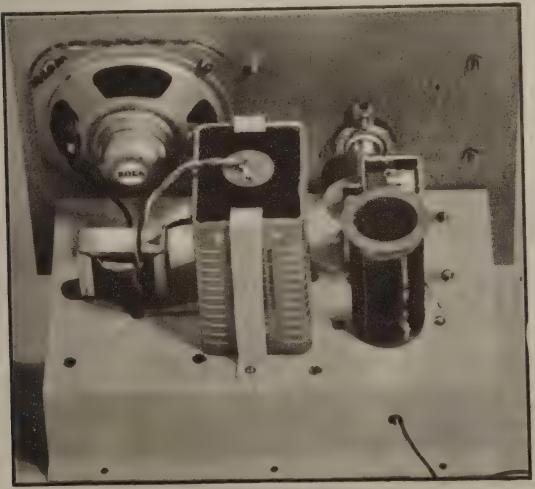
But a manufactured receiver will leave its owner as ignorant as ever of technicalities and there is much to be said for building up a small regenerative receiver, with a view to gaining experience, particularly if savings can be effected by judicious buying from surplus sources.

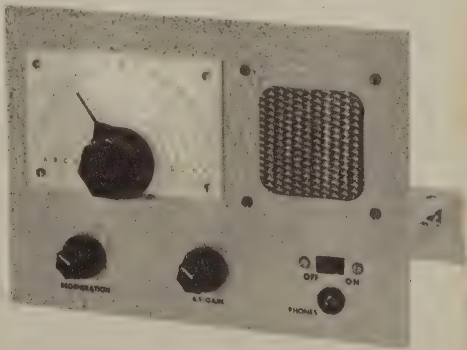
From a home-built receiver, many prospective constructors may be quite satisfied with broadcast station reception only. However, others may fancy the prospect of listening to conversations between Amateur Radio operators and tuning to overseas short-wave stations. To cater for both tastes we have made provision for plugging in different coils. If broadcast reception only is required, one coil only need be wound. Should the short-wave urge develop at a later date, additional coils may be provided.

The coil data supplied allows the receiver to tune radio signals between 500KC and 20MC. The broadcast coil gives sufficient tuning range to cover the University of N.S.W. broadcasts on 1750KC, a feature that will have some appeal for N.S.W. readers. The coils have been designed to give a small overlap in the tuning ranges, so that no portion between the abovementioned limits will be omitted.

While some may require this receiver to operate as a "mantel" set with loudspeakers, others may prefer to use headphones. Provision is made, by the use of a suitable phone jack, to cut out the speaker when earphones are plugged in. This allows the set to be operated at any time of the day or night, without disturbing other occupants of the house. Although the power output is in the vicinity of 45 milliwatts only, this can represent quite a lot of noise in a quiet situation.

Referring to the circuit diagram it will be noticed that three transistors in all are used. The first transistor is a 2N372, 2N370 or 2N371, all of which are designed for high frequency applications. This class of transistor is commonly referred to as a "drift" transistor and its use allows the detector circuit to operate efficiently to the top of the frequency range selected for our re-





Above: Front view of the complete receiver. Output may be directed to either the internal speaker or a pair of headphones. Frequency range is from 550KC to 20MC.

Left: Rear view of the receiver, showing general layout. Note the Planetary drive in front of the turning capacitor.

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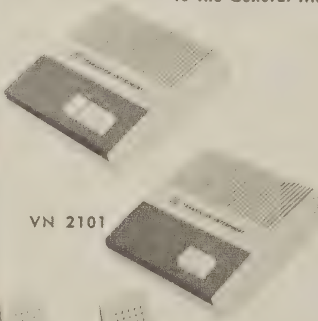

VN 2101

VL 290

MODEL	DESCRIPTION
VN2101	2 Station table type (illustrated)
VN2102	3 Station table type
TO101	Multiplex, master, 5 Stations
TO202	Multiplex, master, 10 Stations
TN701A	Slave unit
TP901	2 Station table set
VL290	2 Station standphone (illustrated)
VN1102S	2 Station door phone — hand phone

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ceiver. An alternative detector transistor suggested in our circuit diagram is a diffused alloy transistor, AF115N, with similar properties to the drift transistor.

The circuit which selects the frequency to which the receiver is tuned comprises the plug-in coil and a variable capacitor of approximately 10-415pF. The signal from the aerial is injected into the tuned circuit via a tap on the coil in the three lower bands and separate primary winding on the highest frequency coil.

This represents a slight departure in method from that suggested for the circuits last month, but there is no special significance in this. Separate primary windings and tappings on the tuned secondary are both legitimate methods of introducing signals from the aerial.

Next comes the tuned circuit itself. To obtain maximum transfer of energy from one circuit to another it is necessary to consider their relative impedance levels. The tuned circuit exhibits a high impedance between the two ends of the coil, whereas the transistor detector has a relatively low impedance input. To obtain a good impedance match it is necessary to connect the coupling capacitor from the base of the transistor to a tap on the coil, as shown.

The base and emitter circuit of a transistor, considered alone, is not unlike a simple "crystal" diode, with its property of passing current more readily in one direction than the other. In effect, the incoming signal is rectified or "detected" by the diode action of the base-emitter junction.

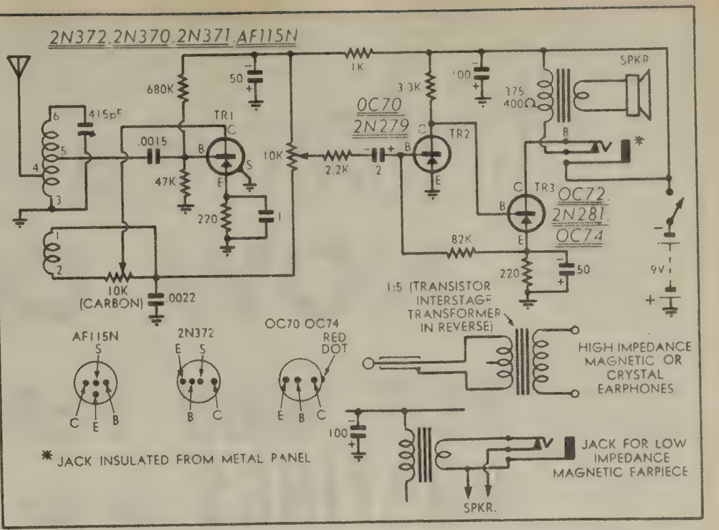
The signal currents, which are "detected" in the emitter-base circuit, also exercises an effect upon the current flowing between emitter and collector. Here amplification is evident, small signal current changes in the emitter-base circuit causing much larger current changes in the emitter-collector circuit.

This means that if we were to place a suitable headphone circuit in the return from the collector we would be able to listen to the program of the station to which the tuned circuit is set. Since the signals are amplified as well as detected, the output would exceed that obtained from a normal crystal set.

This arrangement, while practical, leaves something to be desired in terms both of gain and selectivity. Fortunately, there is a simple solution. The detector transistor, being a high-frequency drift transistor, is capable of amplifying the original RF signals quite efficiently and these appear also at the collector. This amplified RF may be used in a regeneration circuit to increase the selectivity and sensitivity of the detector circuit by a large degree.

To achieve regeneration it is necessary to couple the amplified RF back into the tuned circuit in the correct phase so that it will assist the original signal. In our circuit we achieve this feedback through a winding coupled closely to the original tuned circuit. This winding forms part of the collector circuit of the detector transistor.

A potentiometer is used in the feedback circuit to give the correct amount of regeneration. If too much feedback is used the circuit will become unstable and it is necessary to set this control very carefully for the best results. The setting will vary for different sections of the tuning range and from band to band.

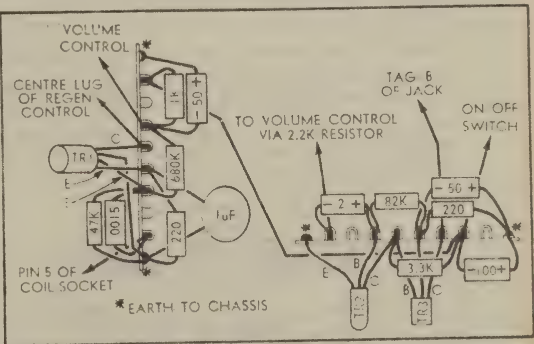


The circuit features a form of direct coupling between the audio and output stage. This also provides thermal stability for the output stage, under high ambient temperature conditions. Note also the alternative headphone output circuits.

However, our coils are designed so that sufficient regeneration can be achieved on all bands.

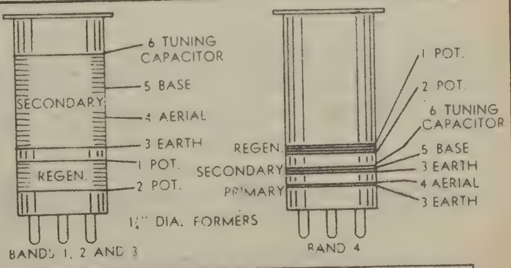
The audio section of the receiver consists of two transistors directly coupled. This particular circuit saves a number of components by using a simplified thermal stabilisation circuit. With this circuit the audio output will drop if the transistors are subjected to a high ambient temperature. However, this fall in output is brought about by a reduction of current flow in the output transistor circuit and the system thus "fails safe," causing no damage to the transistors.

For the second transistor in our receiver we selected an OC70 or 2N279 transistor. This transistor may be used in combination with either an OC72, 2N281 or OC74 in the output stage. While the OC72 is not a current type we feel that there may be quite a few of these transistors in the hands of our readers. For anyone who happens to have available a TS1 and a 2N185 these may be used instead of the 2N279 and 2N281 respectively with one minor alteration. This involves replacing the 82K resistor in our circuit with a 68K resistor.



***Above:** Wiring diagram showing how most of the components are mounted on two tagstrips. Compare this with the photo on page 41.*

***Right:** Coil winding data showing number of turns and method of winding for each band. These data may be modified slightly, on an experimental basis, for best results in each case.*



BAND	PRIMARY	SECONDARY	TAPS	REGENERATION
BC	—	110.5	10,20,30,50	30
2-5MC	—	25.5	3,6,9,12	8
4-12MC	—	10.5	1,2,3,5	4
9-20MC	2	3.5	1.5	4

BC COIL WOUND WITH 31SWG ENAMELLED WIRE. ALL OTHERS 24SWG. NOTE THAT BAND 4 COIL HAS AN ADDITIONAL WINDING. ALL COILS ARE CLOSEWOUND IN THE SAME DIRECTION WITH WINDINGS SPACED 1/8".

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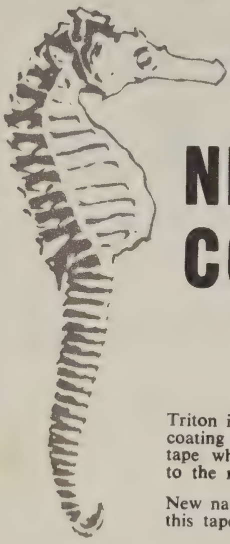

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	5"	600'	27/6	13/9
	5¼"	800'	39/-	19/6
	7"	1500'	48/-	24/-
ACETATE 1 mil. Long Play Blue Seal	5"	900'	40/-	20/-
	5¼"	1200'	54/-	27/-
	7"	1800'	69/-	34/6
MYLAR 1 mil. Long Play Orange Seal	3"	225'	12/-	6/-
	5"	900'	45/-	22/6
	5¼"	1200'	63/-	31/6
	7"	2000'	77/6	38/9
MYLAR .5 mil. Tensilized Super Play Purple Seal	3"	300'	18/6	9/3
	5"	1200'	62/-	31/-
	5¼"	1800'	84/6	42/3
	7"	3000'	124/-	62/-
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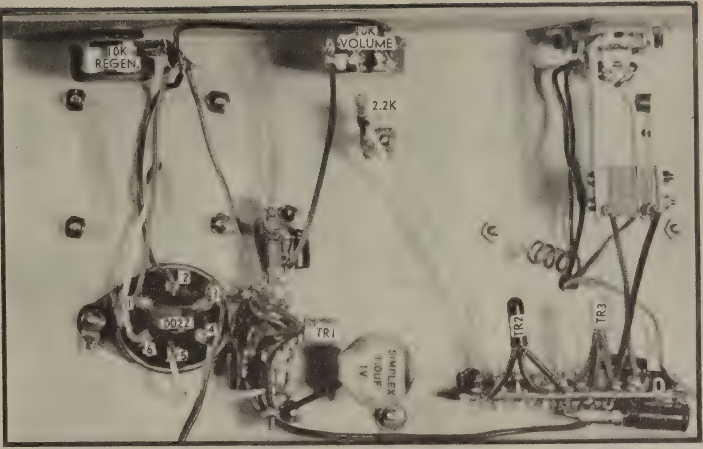

This underchassis view should be studied in conjunction with the wiring diagram on page 39. Note the coil socket orientation and that pins 1 and 6 are the two larger ones.

The output transistor is run in class-A, which means that there is a steady drain on the battery. In larger transistor radios, use is made of push-pull class-B stages which only draw heavy current during audio peaks, resting the battery in between. The total current drain of this receiver is approximately 16.5mA with a 9-volt battery. This is not an excessive figure but, as is usual, best economy will be obtained by using larger rather than smaller batteries.

The relatively low output impedance of the class-A power amplifier is ideally suited to low-impedance head phones, of DC resistance of about 200 ohms, and our prototype has the headphone jack arranged to suit. However, for those readers who prefer to use high-impedance phones or a very low impedance magnetic plug-in earphone, conversion details of the output circuit are given.

To obtain reasonable results with high impedance, about 2,000 ohms, headphones it is necessary to use a step-up transformer of approximately 5:1. A suitable transformer is a transistor driver stage transformer used in reverse.

Very low impedance magnetic earphones, such as those used with portable transistor receivers, require a different approach again .The jack in this case should be wired into the secondary circuit of the output transformer, thus achieving a reasonable impedance match between the output collector and the low-impedance earpiece.

Coming now to the physical side, the receiver panel and chassis were designed to allow the unit either to be screwed on a plywood base or fitted into a wooden box. The box would require a lift-up lid for coil changing, unless one band of frequencies only is used. The use of a metal front panel minimises the possibility of hand capacitance effects on the tuning of the receiver.

PRE-WIRED TAGSTRIPS

To simplify construction the receiver has been divided into three major sections. Two of these are tagstrips which are pre-wired before mounting on the chassis. The third section is composed of front panel and chassis, together with the larger components.

The first tagstrip is pre-wired with all the detector stage components and, after it is fastened to the chassis, requires only four wires for connection to other sections of the receiver. The second tagstrip with most of the audio components, similarly has only four wires to connect to components mounted on the chassis.

By pre-wiring these tagstrips to the drawings supplied, the construction of the receiver becomes simple enough for the youngest and most inexperienced of our readers.

Bending the chassis should present little worry and may be tackled by using two pieces of angle iron in a vyce, tapping the section to be bent with a block of wood and a hammer. Sometimes the bend can be made easier by scoring the aluminium on the side which will become the inside of the bend.

After manufacturing the panel and chassis, the larger components should be mounted, ensuring that the dial and tuning capacitor are in exact alignment. Before mounting the tuning capacitor solder a lead of wire to the fixed plates and pass it through a hole in the chassis ready for wiring.

The smaller components may now be wired to the two tagstrips, carefully following the wiring diagram supplied. The audio tagstrip is then mounted on the chassis with the OC70, 2N279, etc., pointing towards the centre of the chassis.

The detector tagstrip is mounted with the 1K resistor closest to the front panel.

Commence the wiring by connecting the output leads of the speaker transformer to the speaker. Next the wire from the tuning capacitor fixed plates should be soldered to pin 6 of the coil socket. Pins 1 and 2 of the coil socket can now be wired to opposite ends of the regeneration control and pin 1 connected to pin 3 via a .0022uF ceramic capacitor. If the regeneration control is required to increase regeneration with clockwise rotation, the accepted standard, then pin 1 of the coil socket should be connected to the left hand lug (rear view) of the control and pin 2 to the right hand lug.

Pin 3 of the coil socket is connected to a solder lug underneath the socket

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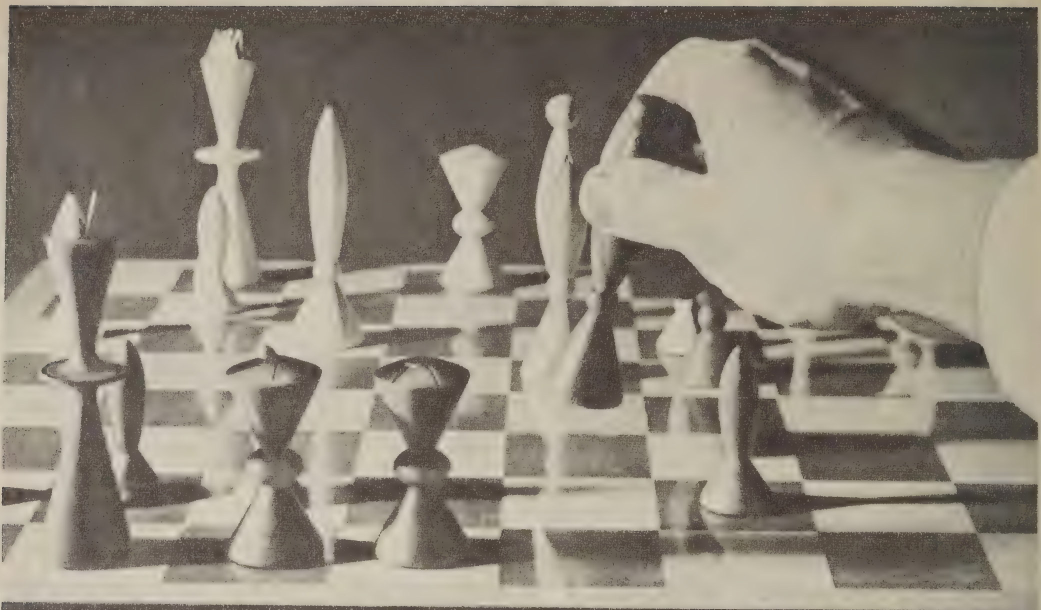
M488 MSP 11-63



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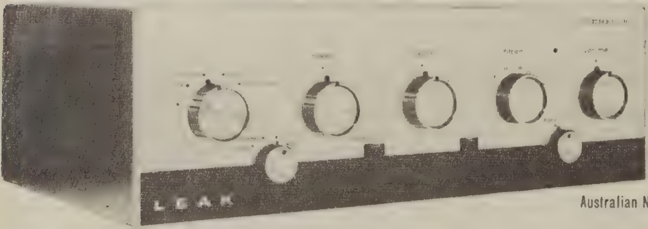

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FACTS AND FIGURES

TRANSISTORS: 2-AC107, 4-GET113, 2-OC44, 2-AF118, 2-GET538, 2-AC12/Z, 4-AD140.
DIODES AND THERMISTORS: 2-20AS, 2-VA1055. 2-VA1039.
POWER OUTPUT: Ten watts per channel into a 15 ohm load. Fifteen watts per channel into a 4 ohm load. (Both figures are IHFM music rating).
DISTORTION: Total harmonic distortion is 0.1% for 8 watts output per channel into a 15 ohm load. (IHFM)
POWER CONSUMPTION: 40 watts.
INPUTS: Five position switch for Pick-up (Mono or Stereo), Tape Head (Mono or Stereo), Tuner (Mono or Stereo), Tape Amp. (Mono or Stereo) — and Microphone (Mono or Stereo).
SENSITIVITY: **Pick-up** . . . 3.5 mV at 47k ohms, 20 mV at 33k ohms, 60 mV at 100k ohms. **Tape Head** . . . 3 mV at 40k ohms. **Tuner** . . . 100 mV at 100k ohms or 500 mV at 50k ohms. **Tape Amp.** . . . 125 mV, **Microphone** . . . 3 mV (Mono or Stereo).
FREQUENCY RESPONSE: Plus or minus 1 dB 30 c/s to 20 kc/s.
FUNCTION SWITCH: For Mono, Stereo, both channels Left, both channels Right.
BASS CONTROL: Continuously variable, plus or minus 16 dB at 50 c/s.
TREBLE CONTROL: Continuously variable, plus or minus 16 db at 14 kc/s.
FILTER AND SLOPE: Turnover frequencies 4, 6 and 9 kc/s. Used with the treble control gives extremely wide range of high frequency attenuation.
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mounting screw. A wire is extended out through a hole at the back of the chassis from pin 3 and 4 of the socket being the earth and aerial connections respectively. The remaining pin 5 is connected to lug 9 of the detector tagstrip.

Pin 2 of the detector tagstrip is wired to pin 3 of the audio tagstrip to supply battery voltage to the detector circuit. Lug 4 of the detector tagstrip is joined to the left hand lug, rear view, of the volume control while lug 5 of the detector tagstrip is joined to the centre lug of the regeneration control. This completes the wiring of the detector circuit.

A two terminal tagstrip is mounted by the screw holding the battery retaining clip close to the volume control. A 2.2K resistor joins the insulated lug of the tagstrip to the centre lug of the volume control. The remaining lug on the volume control is wired to one side of the regeneration control. This must be the side that is wired to pin 1 of the coil socket.

From the vacant end of the 2.2K resistor a connection is made to lug 9 of the audio tagstrip. Lug 3 of the audio tagstrip goes to one side of the on/off switch, the other side of which is connected to the negative lead from the 9-volt battery.

The wiring of the output transistor collector circuit will depend on the type of earphones to be used. The various configurations are shown on the main circuit diagram and are relatively simple to follow. The positive lead from the battery is connected to the chassis completing the wiring of the receiver.

PARTS LIST

- 1 3in loudspeaker.
- 1 Speaker transformer (400 ohms primary, secondary to suit loudspeaker).
- 1 Tuning capacitor, 10-415pF.
- 1 Dial with vernier drive.
- 1 6-pin socket.
- 1 9-volt battery, 276P or similar.
- 1 Plug for above battery.
- 1 Phone jack.
- 1 Slide type on/off switch.
- 2 10K carbon potentiometers.
- 2 10-lug tagstrips, both end lugs with mounting feet.
- 1 2-lug tagstrip.
- 4 6-pin plug-in coil formers, 1¼ diameter.

SEMI-CONDUCTORS

- 1 2N372 transistor, or equivalent.
- 1 OC70 transistor, or equivalent.
- 1 OC72 transistor, or equivalent.

RESISTORS (all half watt)

- 2 220 ohm.
- 1 1K.
- 1 2.2K.
- 1 3.3K.
- 1 47K.
- 1 82K.
- 1 680K.

CAPACITORS

- 1 .0015uF, ceramic, low voltage.
- 1 .0022uF, ceramic, low voltage.
- 1 1uF, ceramic, low voltage.
- 1 2uF 12VW electrolytic.
- 2 50uF 12VW electrolytics.
- 1 100uF 12VW electrolytic.

MISCELLANEOUS

Metal for chassis and panel, plywood, spaghetti, hookup wire, screws, nuts, resin-cored solder, expanded aluminium grill, etc.

Take care that the polarity of the battery is not reversed, otherwise the transistors will be destroyed.

While any orientation of the coil socket will work, for best layout of the wiring it is suggested that pins 1 and 6 should face the end of the chassis. The data for winding all the coils is given in the accompanying diagram. Note that the coil for band 4 has an additional winding. This winding is necessary to couple the aerial efficiently on this range as it would be difficult to tap the tuned winding with its small number of turns as we have done on the other coils.

It will be noticed in the first three coils that there are more taps than can be used. One of these taps is for the aerial and another for the transistor base connection. When first trying the coils, connections to these taps should be varied for best results and this combination permanently wired to the coil pins specified. In general we found that the first tap appears best for the aerial and the third or fourth tap for the base.

In general, moving either the aerial or base connection away from the earthed end of the coil will increase the strength of the signals, but impair the selectivity. The best compromise has to be struck for each individual location and for each aerial installation.

This chapter of the Basic Radio Course is the last one to appear as a regular feature. However, we have in mind to run additional chapters from time to time, some of the subjects still to be covered being Magnetic Recording, Television, and similar branches of the electronic art. In the meantime, our younger readers may rest assured that their interests will not be overlooked. Other articles and projects are being planned to suit their needs.

When the receiver is fully wired and re-checked for mistakes plug in the broadcast coil and switch on. With the volume control advanced and the regeneration control turned off, try tuning for a local station. If you live in a city area it is quite likely that several will be heard and possibly interfering with each other. Advancing the regeneration control will increase the volume of the receiver and will also increase the selectivity to allow the separation of the stations. The volume can be adjusted separately by means of the volume control potentiometer.

As the regeneration control is advanced a stage will be reached where there is a distinct whistle as you tune over a station. This indicates that too much regeneration is being used and the control should be turned back slightly. A little practice will soon accustom the beginner to the tricks of regeneration. At this stage various combinations of the coil taps may be tried to achieve the best results.

The other coils may now be tried and their taps also adjusted. Remember this is a small receiver and does require an efficient aerial and earth system. The earth may be run from a nearby water tap or a reasonably large piece of metal buried in the ground. An aerial wire of at least 30 feet in length well elevated is desirable. ▬

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A COMPLETE MONO RECORDER USING

THE 'PLAYMASTER 110' TAPE AMPLIFIER UNIT

— AND CONCLUDING COMMENTS

In last month's issue we described a power unit which together with two of our "Playmaster 110" tape amplifiers makes a complete stereo recorder. This article describes a modified version of the recorder power unit having a single push-pull output channel, for those wishing to make a complete high-quality mono recorder. It also gives details of a modification which improves signal-to-noise ratio on replay.

By Jamieson Rowe

RIGHT at the outset we should mention that we have not made up a complete mono power unit exactly as it is described in this article; time simply would not allow us to do so. However, the circuit is not simply an "on paper only" design. It has never been our policy to publish designs which we have not tried out, as regular readers will be aware, and the design presented here is no exception.

In fact, the design has been mocked up, using the power supply and bias oscillator sections of the stereo design and a "borrowed" push-pull amplifier channel from the laboratory prototype of the "Playmaster 101 Basic Amplifier" described in August, 1962. The mockup was used to verify that it does indeed work as our paper work predicted.

In other words, the design has been tested in practice and in this respect is no different from any other of our designs. The only point of difference is that a complete new unit has not been assembled for photographic purposes. Quite apart from the time problem this would have involved fairly costly duplication, so in view of the straightforward nature of the design and the relatively small differences between it and the stereo unit we decided that it was unnecessary.

The circuit for the mono power unit is as shown. Comparison with the circuit of the stereo unit will show that the power supply circuitry is unchanged. The bias/erase oscillator is also identical, although a minor point to note is that the erase head connection is now taken from the orange secondary tap rather than from the green tap, to give more appropriate matching to a single head.

It is in the audio output section that the main changes have been made. Two 6GW8 valves are used but, whereas they were used before in individual single-ended stereo channels, they are now used together in a push-pull mono channel.

As indicated earlier, the amplifier circuitry used is almost identical to that of the channels of the Playmaster 101 Basic Amplifier—one of the prototype 101 channels, in fact, being used in our mockup.

The circuit is quite straightforward and delivers in this application approximately 11 watts RMS. The frequency response is flat within 1dB over the range 40 cps—19KC, the —3dB points being at 30cps and 28KC. Thus the overall response of the recorder will be substantially that of the Playmaster 110 amplifier, and will be capable of excellent recording and reproduction.

The use of a medium-quality but ultra-linear output transformer (such as the Ferguson type OPM7-A or similar) gives low distortion over the audio range. Typically it will be less than 1 per cent at full output for all frequencies above about 70cps, and little more than 1 per cent for the small segment of the range below this frequency.

Some readers may be wondering why this amplifier and those of the stereo power unit have a response which rolls off fairly rapidly above the audio range. This roll-off is quite intentional and has been arranged so that the system gain is low at supersonic frequencies. In a tape system, where replay equalisation involves substantial treble boosting and where supersonic bias signal can find its way into the audio channel, extended response is not only unnecessary but often embarrassing. Deliberate restriction improves the system stability margin and helps solve the bias injection problem.

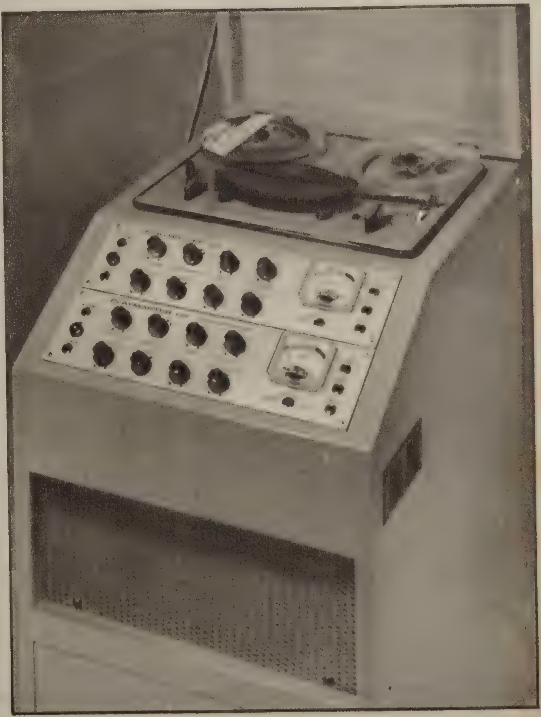
The HF attenuation is achieved in the unit being described by the 27pF feedback capacitor between the plate of the V1 pentode and the cathode of the first triode.

Physically, the mono recorder power unit is very similar to the stereo unit. Above the chassis, which is the same in both cases, the only difference will be that the mono unit will have a single and slightly larger output transformer in place of the two transformers on the stereo version.

Underneath the chassis the appearance will be again very similar, as the power supply and bias/erase oscillator circuitry is identical. We have prepared a wiring diagram giving a suggested layout of parts and wiring in the audio amplifier section and repeating the wiring of the power and oscillator sections. Thus, there should be no difficulty in constructing the unit even for those with little wiring experience.

We should like to draw the attention of readers to a fact concerning Brenell half-track mono three-head decks which has only recently been drawn to our own notice. The point is an important one but it had escaped the notice of ourselves and others due to ambiguity in the manufacturer's information.

The fact is that there is a single medium-to-high impedance half-track



The prototype system as finally assembled. Two type 110 amplifier units and a stereo recorder power unit are used together with a Brenell deck to form a complete stereo recording console, for use in our laboratory. Readers could build their system into a smaller, portable case similar to the top of this unit, with the speakers mounted at the sides.

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MODEL IB

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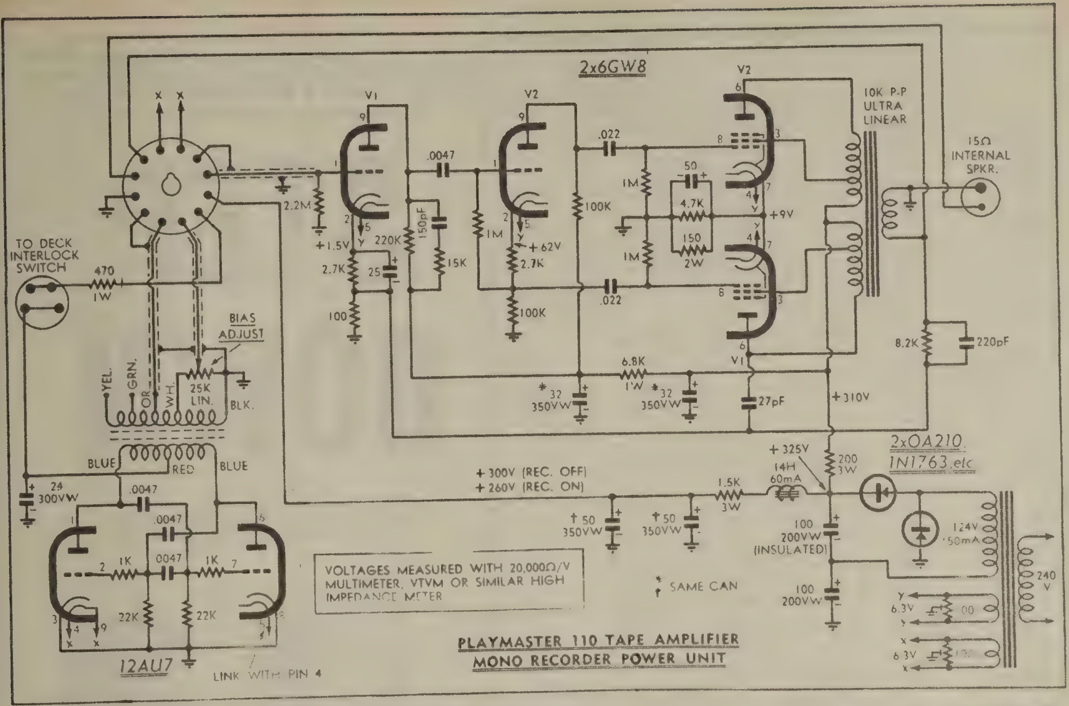


Above is the circuit diagram for the mono recorder power unit, which combines with a single type 110 amplifier to form a complete mono recorder. The wiring diagram appears on the next page. At lower right is a view of the prototype console, illustrating one way of housing the system.

mono R/P head type, of which two are used for three-head decks and only one for two-head decks. There is no low impedance recording head as used in the "stereo" decks. Because of the characteristics of the half-track mono R/P head, bias and audio feed will have to be changed from those specified. This will apply to both two- and three-head half-track mono decks.

More bias voltage is required, and this can be provided by using the bias connections specified in the May issue for the Truvox and Collaro decks (i.e., use the YELLOW coil tap). Also less audio feed is required, and this will occur wtih usual level meter indications if one simply reverses the positions of the 33K and 68K/1W resistors in the plate circuit of V3a.

Head connections and modifications to basic circuitry required for decks other than the Brenell have been given in the preceding articles, along with details of adjustments required when the system is completed.

This completes the description of the mono recorder power unit. Before drawing this article to a close, however, we would like to give details of a modification to the type 110 amplifier which improves the replay signal-to-noise ratio. The matter of a suitable case or console for the system will also be discussed.

The modification consists of the addition of a bridge rectifier circuit to supply the heaters of the replay EF86s with DC. Typically the replay hum level is reduced by some 7 to 9dB by this procedure, which is thus quite worthwhile. The cost of additional components is quite small.

The small circuit and diagram show details of the modification. Four low-voltage silicon power rectifier diodes are

Mono Recorder Power Unit

PARTS LIST

- 1 Chassis, 11in x 9in x 1¼in.
- 1 Power transformer, 124V at 150mA, 2 x 6.3V at 3A, flat mtg.
- 1 Output transformer, medium quality, 10K P-P to 15 ohms.
- 1 Filter choke, 14H at 60mA.
- 2-6GW8 valves, 1-12AU7 valve.
- 1 Bias osc. coil (RCS type 265).
- 2 Silicon power diodes, OA210 or similar.

RESISTORS (½ watt unless marked)

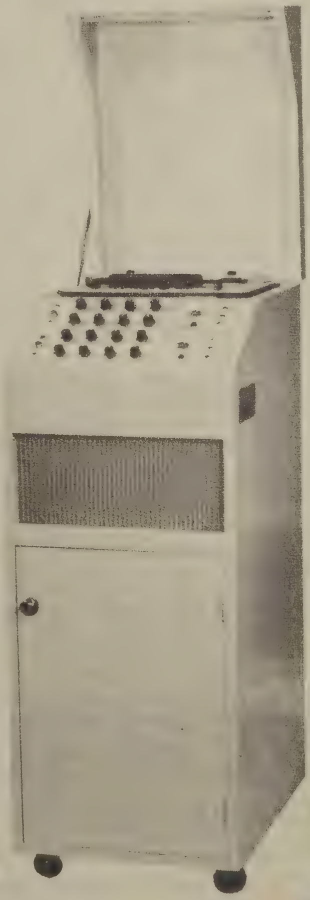
1 x 100, 1 x 150/2W, 1 x 200/3W, 1 x 470/1W, 2 x 1K, 1 x 1.5K/3W, 2 x 2.7K, 1 x 4.7K, 1 x 6.8K/1W, 1 x 8.2K, 1 x 15K, 2 x 22K, 2 x 100K, 1 x 220K, 3 x 1M, 1 x 2.2M, 2 x 100ohm slider pots, 1 x 25K lin pot.

CAPACITORS

1 x 27pF, 1 x 150pF, 1 x 220pF, 3 x .0047uF 600V, 1 x .0047uF 400V, 2 x .022uF 400V, 1 x 24uF 300VW electro, 1 x 25uF 3VW electro, 1 x 32-32uF 350 VW dual electro, 1 x 50uF 10VW electro, 1 x 50-50uF 350VW dual electro, 2 x 100uF 200VW electro, one insulated.

MISCELLANEOUS

3 x miniature 9-pin valve sockets; 12-pin socket, polarised 2-pin speaker socket and plug, miniature 4-pin plug and socket; 18-lug length of miniature resistor panel; 2 x 10-lug, 3 x 6-lug miniature tagstrips; power cord and plug; nuts, bolts, wire, grommets, etc.



TYPE NO.	PRIMARY VOLTS	SECONDARY RATING	OUTLETS
		SOLDERING IRON TRANSFORMERS TAP CHANGING PLUG ON SECONDARY	INSULATED TERM.
TS7/20	240	5, 6 or 7V-20 Volt amperes	
TS8/30	240	6, 7 or 8V-30 Volt amperes	Two
TS12/40	240	10, 11 or 12V-40 Volt amperes	
		SOLDERING IRON TRANSFORMER	
TS3.3/60	240	3 3V—60 Volt amperes cont.	Two
	ECONOMY RANGE	6V STEPDOWN TRANSFORMERS Enclosed in pressed Steel covers	2 PIN POLARISED SOCKET
TS6/30	240	6V—30 Volt amperes	One
TS6/60	240	6V—60 Volt amperes	One
		FUSE MASTER RANGE STEEL CASE TYPE.	
TS6/60A	240	6V—60 Volt amperes	One
	ECONOMY RANGE	12V STEPDOWN TRANSFORMERS Enclosed in Pressed Steel Covers	2 PIN POLARISED SOCKET
TS12/12	240	4, 8, and 12V—12 Volt amperes	3 Terminals
TS12/30	240	12V—30 Volt amperes	One
TS12/60	240	12V—60 Volt amperes	One
TS12/100	240	12V—100 Volt amperes	One
		FUSE MASTER RANGE STEEL CASE TYPE	
TS12/30A	240	12V—30 Volt amperes	One
TS12/60A	240	12V—60 Volt amperes	One
TS12/125A	240	12V—125 Volt amperes	Two
	ECONOMY RANGE	24V STEPDOWN TRANSFORMERS Enclosed in Pressed Steel Covers	2 PIN POLARISED SOCKET
TS24/30	240	24V—30 Volt amperes	
TS24/60	240	24V—60 Volt amperes	One
TS24/100	240	24V—100 Volt amperes	One
TS24/200	240	24V—200 Volt amperes	One
		FUSE MASTER RANGE STEEL CASE TYPE	
TS24/30A	240	24V—30 Volt amperes	One
TS24/60A	240	24V—60 Volt amperes	One
TS24/125A	240	24V—125 Volt amperes	Two
TS24/200A	240	24V—200 Volt amperes	Two
TS24/500A	240	24V—500 Volt amperes	Two
	ECONOMY RANGE	32V STEPDOWN TRANSFORMERS Enclosed in Pressed Steel Covers	2 PIN POLARISED SOCKET
TS32/30	240	32V—30 Volt amperes	One
TS32/60	240	32V—60 Volt amperes	One
TS32/125	240	32V—125 Volt amperes	One
TS32/200	240	32V—200 Volt amperes	
		FUSE MASTER RANGE STEEL CASE TYPE	
TS32/30A	240	32V—30 Volt amperes	One
TS32/60A	240	32V—60 Volt amperes	One
TS32/125A	240	32V—125 Volt amperes	Two
TS32/200A	240	32V—200 Volt amperes	Two
TS32/500A	240	32V—500 Volt amperes	Two
TS32/750A	240	32V—750 Volt amperes	Two
TS32/1000A	240	32V—1000 Volt amperes	Two
	ECONOMY RANGE	115V STEPDOWN TRANSFORMERS Enclosed in Pressed Steel Covers	2 PIN SOCKET FLAT
TS115/30	240	115V—30 Volt amperes	One
TS115/60	240	115V—60 Volt amperes	One
TS115/100	240	115V—100 Volt amperes	One
TS115/150	240	115V—150 Volt amperes	One
TS115/200	240	115V—200 Volt amperes	One
TS115/300	240	115V—300 Volt amperes	One
		FUSE MASTER RANGE STEEL CASE TYPE	
TS115/30A	240	115V—30 Volt amperes	One
TS115/60A	240	115V—60 Volt amperes	One
TS115/125A	240	115V—125 Volt amperes	One
TS115/200A	240	115V—200 Volt amperes	One
TS115/500A	240	115V—500 Volt amperes	One
TS115/750A	240	115V—750 Volt amperes	One
TS115/1000A	240	115V—1000 Volt amperes	One
TS115/2000A	240	115V—2000 Volt amperes	Two

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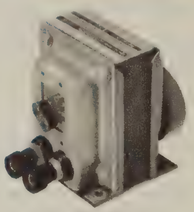

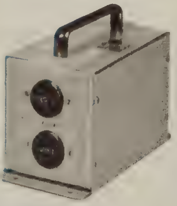

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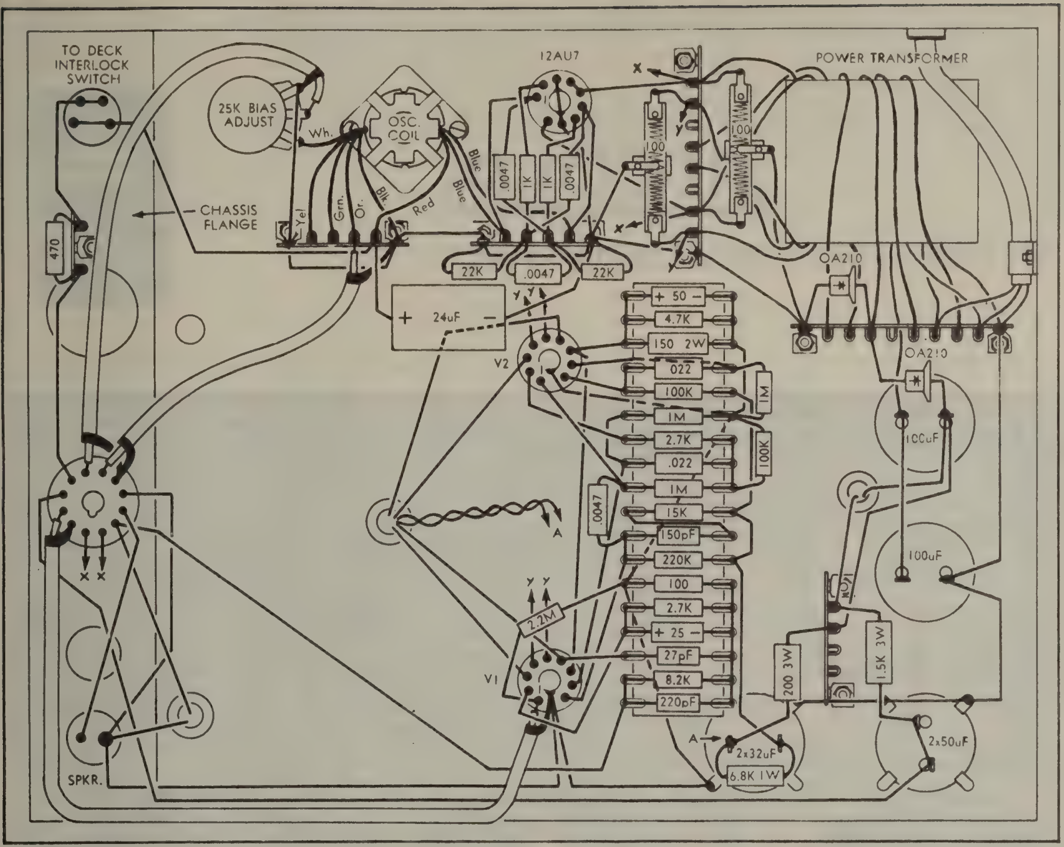

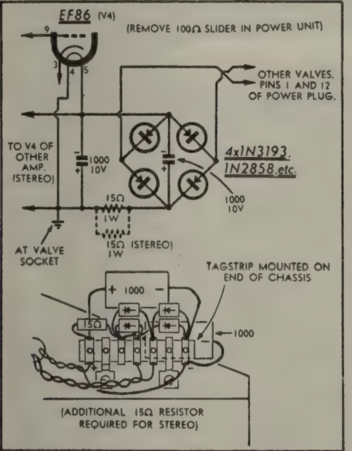
EF86 (V4)
(REMOVE 100Ω SLIDER IN POWER UNIT)
9
3
4
5
OTHER VALVES. PINS 1 AND 12 OF POWER PLUG.
TO V4 OF OTHER AMP. (STEREO)
1000 10V
4x1N3193, 1N2858, etc.
1000 10V
15Ω 1W
15Ω (STEREO) 1W
AT VALVE SOCKET
TAGSTRIP MOUNTED ON END OF CHASSIS
+ 1000 −
15Ω
1000
(ADDITIONAL 15Ω RESISTOR REQUIRED FOR STEREO)

Above is the suggested wiring diagram of the mono recorder power unit, intended to aid those without the experience necessary to wire up the unit directly from the circuit. Note the shield braid earthing details carefully. At left are details of the heater circuit modification.

ERRATUM

In the main circuit of the Playmaster 110 Amplifier Unit, as published on page 29 of the March issue and (corrected) on page 65 of the May issue, a 100pf capacitor was shown connected between the grid of V3a and earth. As indicated by the wiring diagram, the capacitor is actually connected between the grid of V2b and earth.

See text for further suggested modifications to the design to improve noise and stability.

used in the bridge, which is inserted in the EF86 heater line of one amplifier unit. Filtering of the bridge output is provided by 1000uF electrolytic capacitors and series resistance. The latter is provided by two 15 ohm resistors in parallel for stereo or a single 15 ohm resistor for mono.

The components are supported by a miniature 7-lug tagstrip which is mounted on the end of the bracket chassis of the amplifier unit. The wiring of the components should be a simple matter using the wiring diagram as a guide.

Note that a separate rectifier unit is not required where two type 110 amplifiers are being used in a stereo setup. Both of the replay EF86s can be operated from the one unit, the EF86 in the second unit being connected up via a flying lead arrangement after being disconnected from the AC supply of its own unit.

If this modification is made it is necessary to re-balance the heater lines to attain maximum benefit from the change to DC. The procedure will be the same as before, simply a matter of turning up the replay gain controls and adjusting the slider pots for minimum hum output.

There is a modification to the basic mechanical design of the Playmaster 110 amplifier which we have found to be most desirable in the interests of overall stability when the units are used with the RECORDER power units. It is not essential when the amplifiers are to be used with the adapter power unit, but as it is a relatively simple modification it could well be incorporated into all units.

The modification entails isolation of the earthy side of the "output" jack from the front panel metalwork, and also the use of a 4-lug miniature tag-strip at the underchassis termination of the jack cable to complete the isolation of the "output" earth. This prevents speaker currents flowing in the chassis metalwork, and improves stability.

The output jack should be insulated by means of fibre washers and a small bush of cardboard or nylex. The hole in the metalwork may have to be reamed out to allow this to be done. The underchassis change is simply the use of a miniature 4-lug tag-strip in place of the original 3-lug unit, to permit the output earth to be isolated from the chassis. As mentioned previously, the connections between this tagstrip and the jack should be made in twin-shielded cable.

Incidentally, if the mono or stereo recorders are to be fitted into a portable case a low-flux power transformer will be an advantage to reduce hum pickup. We understand that Ferguson Transformers have such a unit, designated type PF1555FT.

(Continued on page 67)

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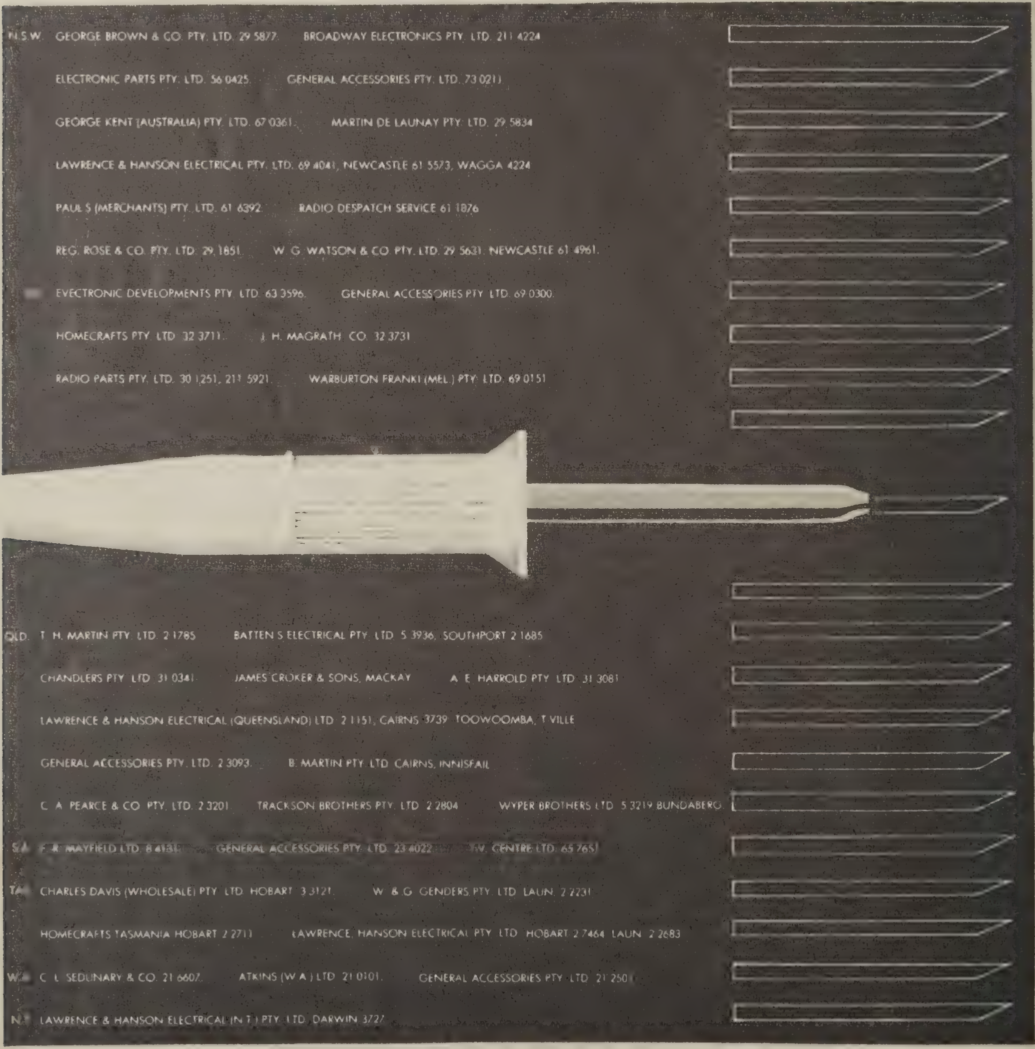

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A READER BUILT IT!

Circuits and devices which we have not actually tested in our laboratory but published for the general interest of beginners and experimenters.

SIMPLE CIRCUIT SHOWS ELECTROSTATIC CHARGES

From Mr Roger Graham, B.Sc., of the Science Department at Kiama High Sshool, comes the following information on a useful but simple piece of demonstration apparatus. It can be built by experimenters, Youth Radio Clubs and science teachers using readily obtainable parts. We reprint the information by the courtesy of the Wireless Institute of Australia.

"This simple circuit may be used to find out or demonstrate whether an electrostatic charge on a comb or plastic pen or perspex strip is positive or negative.

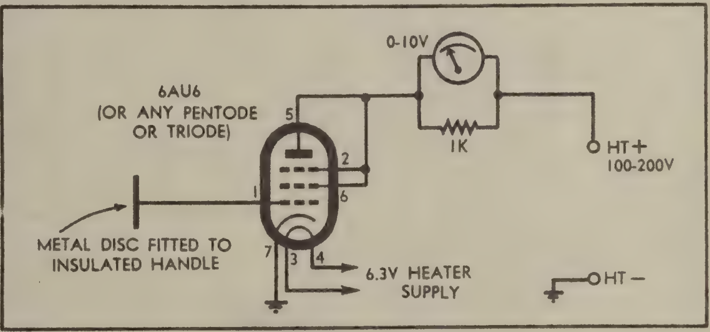
"In the circuit shown the valve may be almost any type, a triode or a tetrode or pentode triode-connected. In the first version made it was a 1T4, but after that was lost a 6AU6 was installed with equally effective results.

"There is no bias on the grid, which is connected to a wander lead terminating in a well-insulated metal plate — in the first unit this was the lid of a deflagrating spoon. The standing current shown on the plate meter is a milliamp or two (with the voltmeter across a 1000 ohm resistor as shown it effectively reads 0-10mA).

"The standing current drops to zero on the approach of a negatively charged object, such as a plastic ball-point pen, toward the metal plate on the wander lead. The effect can be seen from three or four feet away with a larger charged object such as a gramophone record.

"Positively charged objects cause a momentary rise in plate current, but this is not sustained since the positive grid attracts electrons to itself to cancel the induced charge.

"This apparatus was used with a responsive science class who were doing static electricity, and they saw the principles involved immediately. Thus both pupils and teachers should find it well worth the small effort involved in its construction." ■



"Pseudo-Stereo" from mono records using a stereo tape recorder . . .

There are a number of ways by which mono recordings may be "doctored" to give an effect somewhat similar to stero—adjustable filters, reverberation and other techniques are often employed, singly or in combination. The technique described below uses only a better-quality stereo tape recorder, although it is rather time-consuming and calls for a certain amount of skill. Sent to us by the reader who developed it we publish it for the benefit of experimenters and recording enthusiasts.

"Mono recordings can be transformed into a highly entertaining pseudo stereo version incorporating reverberation by a fairly simple procedure and without special equipment. The essential requirement is a stereo tape recorder capable of recording on one channel whilst playing back on the other and which permits monitoring of both channels during these functions. A number of the better-quality machines now available would meet this requirement.

"It is assumed that the gramophone turntable which is used is a reasonably good one able to hold its speed to faily close tolerances during the recording process. The degree of accuracy is most important if it is desired to process lengthy works; for albums made up of a number of short tracks this becomes less important and at times a loss of synchronisation will enhance the end result.

"The method involves the following steps:

(a) Record the required mono material on one track of the tape; if it comprises a number of tracks these can be recorded all at once during this step.

(b) Wind the tape back to the start and prepare to record again, only this time on the other track of the tape.

(c) Set the first channel to replay. Then start the recorder and listen for the first note or sound of the material recorded in the first step. Stop the recorder using the "pause" or "cue" or "Instant stop" control.

(d) Assuming that the recording level is correctly set on the second channel start the record and listen for the first note or sound. When it is heard release the tape machine so that recording commences. This will record the second "stereo" channel with a slight time delay with respect to the first track, and the time delay will be heard in the monitoring speakers or headphones.

"The technique may have to be practised to achieve satisfactory results, and for a given piece of material a number of trials may be necessary to arrive at the most suitable amount of time delay. A turntable fitted with a vernier speed control will allow the delay to be adjusted (and even reversed so that the second recording leads the original) during the recording. With care and patience some most pleasing effects are possible." (From K. F. Williams, 24 Waratah Street, Mona Vale, N.S.W.)

EDITOR'S NOTE: Whether this type of enhancement is worthwhile depends a great deal on personal preference, the listening room and equipment, and the recordings involved. Old 78s, made in the "dead" studios of the time, should be good candidates for the treatment. ■

ELCO-VECTOR

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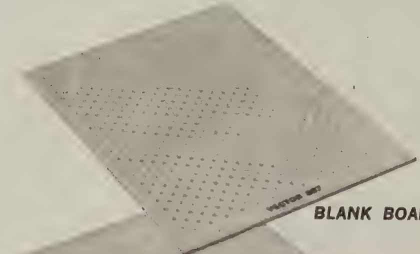
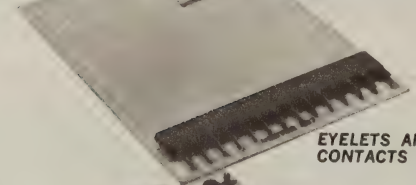
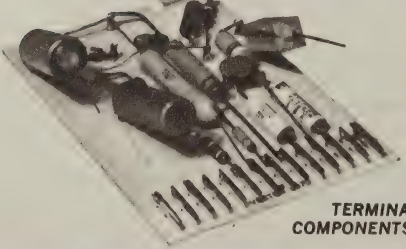
Illustrated below are the four basic stages in the production of a printed circuit wired prototype or plug-in module. Commencing with a blank epoxy paper or glass board, eyelets and Elco male contacts are added individually or in strip form. The plastic backing is then removed from the male contact strips (if necessary) so that components can be wired on to the circuit board, making use of Vector eyelets or the Mini-Klip terminals. When completed, the whole circuit can be plugged into an Elco 5000 or 7000 Series Connector receptacle.



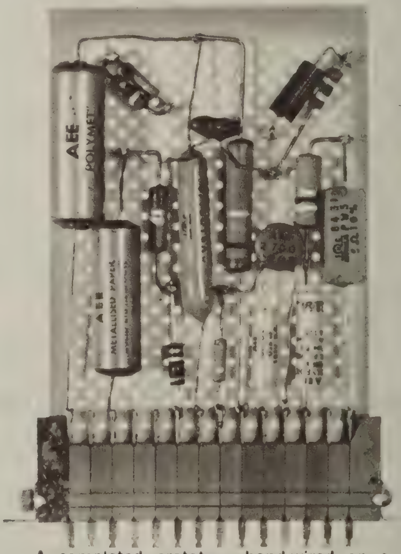
BLANK BOARD



EYELETS AND ELCO CONTACTS FITTED



TERMINALS AND COMPONENTS ADDED



A completed prototype hand-wired on a piece of 3" x 4½" epoxy paper Vector Board plugged into an Elco 5002 Series Connector. This could be the complete circuit in itself or part of a more complex network.

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The Serviceman

BIRTH PANGS OF A NEW CHANNEL

Being the reminiscences of your serviceman concerning the recent advent of channel 10 in the Sydney area, and dedicated to all those sleepy-eyed colleagues who spent long hours on the job before and after the event. Let us hope the customers appreciated the effort.

WELL, we finally got Channel 10 on the air!

Not, I hasten to add, at the transmitting end, where the job was handled most capably by channel 10's engineers, but rather at the other end of the link where a considerable number of sets throughout the Sydney metropolitan area needed some form of adjustment to enable them to receive the new channel correctly. And, for a while, no one was quite sure just how a big a job this was going to be.

Fortunately, in theory at least, almost all the sets currently in use were capable of receiving this channel. Channel 10 formed part of the system right from the first and, apart from a small number of early sets which were released with only 2, 7, and 9 biscuits in their turrets, manufacturers designed their sets to receive it long before its allocation.

True, its frequency was shifted during the reshuffle from 10 to 13 channels, but, again fortunately, by only 1MC. This is a purely nominal shift at 208MC, and well within the adjustment of most slugs or fine tuning controls.

Nevertheless, each set, particularly as far as its owner was concerned, was an unknown quantity. To a lesser extent the same thing applied to the serviceman. While fully aware of all the above facts, he couldn't be quite sure that every thing would work out as smoothly as it should. For one thing, just how good a job had the early manufacturers done on the channel 10 circuits? Had they taken the same trouble as they did for 2, 7, and 9 — which were actually on the air — or had they treated the unused channels as being something so far in the future that they needed only a rough check? Until channel 10 actually began to radiate, few of us could be sure.

THERE IT WAS

As it turned out, most of them seemed to have done a pretty good job. The great majority of owners simply turned the selector to channel 10 — and there it was.

But long before we had a chance to prove it, we were besieged with inquiries from customers.

"What must I do to get channel 10?"

"Will I need a new set?"

"Will it really cost me £5 to convert my set?"

"Can you adjust my set now so that it will be ready when the new channel comes on?"

And so on.

The answers varied, of course. Where it was known that the tuner involved was of reliable make, customers were generally advised to wait for test transmissions, see how the set performed, and then contact the serviceman if there were any problems. These were the easy ones, except that some seemed to think it was so easy that there must be a catch somewhere.

In a few cases — a very few — there were some tuners which had been fitted with 2, 7, and 9 biscuits only and for which spare biscuit mouldings were no longer available. Unfortunately, there was no help for it but to replace these tuners. I did not encounter any of these personally, but a few colleagues did.

HARDER ONES

Those who wanted their sets adjusted completely in advance, and virtually demanded this in some cases, were harder to please. It seemed almost impossible to convince them that this job could not be done until the channel was actually on the air.

Those who imagined that they would need a new set, or had been encouraged by some fly-by-night operators to spend various sums to have their set "converted," were soon pacified and also advised to adopt a "wait and see" attitude.

Then, a week before opening night, channel 10 hit the air with a test pattern and the calls started to come in. To be fair, they didn't represent a very big percentage of the total — probably 5 per cent according to my own and my colleagues' figures—but this didn't stop them from being a substantial number when considered in the light of the time available and the fact that they were additional to the normal service demands which still had to be met.

I'm afraid that week was a pretty hectic one for most Sydney servicemen, and I encountered more than one sleepy-eyed colleague who confessed to working late into the night, for several nights in a row, in an effort to satisfy all his customers.

Fortunately, of those sets which needed adjustment, most needed only a turn or so of the biscuit slug to put the station in the centre of the fine tuning range. These were the easy ones, where one could be in and out of the house in a matter of minutes.

But it wasn't all plain sailing. One unexpected snag was a percentage of jammed slugs; a sure-fire schedule wrecker if ever there was one. The chassis had to come out of the cabinet, the tuner had to be opened, and the faulty biscuit extracted. Then, if you were lucky the slug responded to a little gentle persuasion, was put back in the tuner, the tuner closed, the chassis replaced, and you tried again.

If you were unlucky the slug stayed jammed and you found you had no replacement with you.

Another mechanical problem concerned knobs. Many of the plastic type channel selector knobs have a nasty habit of "freezing" onto the tuner shaft. I am not quite sure why this happens, but I suspect that the particular plastic expands and grips the shaft quite tightly, possibly aided by odd spots of rust which may occur on the shaft. Anyway, whatever the reason, the serviceman finds himself faced with a knob which stubbornly refuses to budge after the grub screw is removed.

REPLACEMENT PROBLEM

To makes matters worse, replacement knobs present a problem. Assuming they are available, some of these types are quite expensive and leave little change out of a pound. This is bad enough, assuming one is unfortunate enough to break one, but it is even worse in those cases where the particular type is virtually unprocurable. This applies mainly to sets made by firms no longer in business.

In the case of one such set which I encountered, it took me three-quarters of an hour to free the knob; a ridiculous situation, and an embarrassing one too, seeing that the owner watched me like a hawk the whole time! But there was little I could do except worry it as patiently as I could and hope that it didn't break.

Another problem was the physical alignment of the various holes which are supposed to provide access to the slug. These were "all over the shop" in many sets and, while I have encountered the problem before, it took this situation to emphasise how often it occurs. Set manufacturers could well take a long hard look at the tolerances which are involved in the placement of these holes.

In one case I encountered there were four holes altogether; one in the cabinet, one in the chassis, one in a bracket immediately behind it — and the purpose of which is rather obscure — and then the one in the tuner.

DIFFICULT JOB

The one in the cabinet was quite generous, but this was just as well because the other three were all offset from it by several degrees. It was only by using a very flexible screwdriver, and by means of a good deal of juggling, that I was able to make contact with the slug at all. Even then, it was a happy accident that placed it close to the front end of the coil former, otherwise I would not have been able to reach it.

Another problem was interference with other channels. This was confined mainly to the North Shore area in the immediate vicinity of the transmitters where, for reasons not yet clear, it was found to be interfering with both channels 7 and 9. There are two strange aspects of this. One is that there should be any interference at all, even with channel 9, since there is nearly as much frequency space between 9 and 10 as there is between 7 and 9. The other is that it should reach as far as 7 and, what's more, was sometimes worse on 7 that it was on 9.

Curing these troubles called for a

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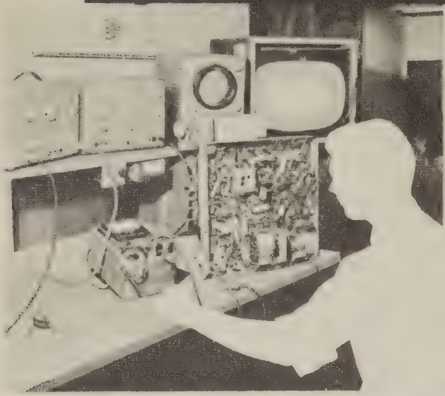

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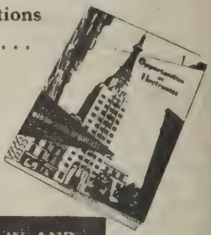

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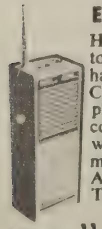

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variety of approaches, and a good deal of ingenuity in some cases. A few sets needed nothing more than a re-setting of the A.G.C. control — possible because the setting was other than optimum anyway. These were the easy ones.

When this failed some means of reducing the imput signal to the tuner, such as a pad, was the next logical step, and this proved successful in the majority of cases.

However, there were a few stubborn ones. Some of these were cases where the feeder line was longer than necessary and, more important, had a large horizontal component. Shortening and re-routing the feeder, plus a pad and AGC adjustment, cured most of these.

STUBBORN CASE

However, one particularly stubborn case nearly beat me. After I had tried all the aforementioned tricks there was still an objectionable level of interference, and I was at something of a loss to know what to do next. Then, quite by chance, I moved the length of feeder running from the skirting board outlet to the set, and found that, in a certain critical position, the trouble vanished.

I'm afraid I took the easy way out and fastened the lead where it would cure the trouble, warning the owner not to move the set or feeder. I wasn't very happy with the arrangement, and plan to take another look at the problem when I have more time. But right then, with a couple of dozen other customers screaming for Channel 10, and time running out, I felt that an emergency cure was justified.

The trouble is almost certainly due to feeder pickup, and the cure to some random effect whereby an out-of-phase signal was being induced in the section of feeder I so carefully arranged. As I said before, not a very satisfactory cure on a permanent basis.

A proper cure may involve a better overall feeder run than I was able to arranged in a limited time or, if this fails, a coax. feeder with appropriate matching baluns. I hope the latter will not be necessary, because it will involve the owner in a significant outlay.

LIGHTER SIDE

But there was at least one amusing sidelight to the advent of the new channel. This was the number of customers who insisted—to both myself and my colleagues—that they could get Channel 10 " . . . on position nine and a half."

I did something of a double take when the first customer confronted me with this explanation, and had to submit to the indignity of having a housewife show me what she meant. She seemed somewhat superior about it, too, and I learned that several of her friends had encountered the same trouble and they all took it for granted that this was the only possible description. And, having made the decision, they assumed everybody else knew about it!

In fact, the condition was one where the new channel could be received by holding the channel selector midway between the 9 and 10 detents, or where the 10 biscuit just made contact with the stationary wipers. However, once the turret was allowed to index properly on the 10 position, the signal was hopelessly detuned.

The explanation is quite simple, of course. The slug was slightly detuned and the additional length of conductor in the tuned circuit, represented by the increased length of wiper in use, was sufficient to compensate for this. Nevertheless, it does serve to emphasise just how critical tuned circuits are at these frequencies and, in turn, how important it is that any tuner index positively and free from mechanical slop.

And, to end the Channel 10 theme, here is a story which may help compensate the fair sex for the sly dig I made at them a few paragraphs back. In the midst of all the hurly-burly, and while working on a set in the workshop, I was approached by a housewife who was one of my regular customers. She, too, was worried about Channel 10, though not in regard to her own set, which had received it perfectly from the start.

Rather, it was her brother-in-law's set which needed attention. I gathered it could receive the station, but was obviously badly detuned. Could I possibly have a look at it for him? She reminded me that he lived in a distant suburb.

It was an awkward situation. In the normal course of events I might have been prepared to make the journey, but it seemed quite out of the question at the moment. I still had a long list of customers whose sets I had promised to adjust, Channel 10 was due to open in about 48 hours, and I needed some sleep. Even assuming I could make the journey, it could not be for several days.

Then the lady made a suggestion: "Bill wondered if he could do it himself if he knew how."

That wasn't such a silly idea. I knew Bill well enough to believe he possibly could. Not that he knew much about electronics, but he was a reasonably bright handyman type who could follow instructions with intelligence. I had little doubt that, had he been beside me in the workshop, I could have shown him what to do in a few minutes.

But what about his sister-in-law? Could I show her what was to be done and expect that she would be able to convey this to him with the necessary accuracy? It seemed a tall order; so much so that I wouldn't have considered it in most cases.

On the other hand, this particular lady seemed above average in grey matter. A retired teacher by profession, she was a keen amateur photographer, who undertook all her own processing and turned out some top quality work. While of little direct value for the problem in hand, I felt it indicated an ability to learn.

In addition, she was able to tell me the make of set, which I recognised as using a Philips tuner. And the chassis I had on the bench at the moment used the same model Philips tuner, so at least I had something to demonstrate.

I decided it was worth a chance. Using a spare biscuit, I pointed out the brass slug and explained how it was adjusted, emphasised the need to use a non-metallic screwdriver, and described how this could be fashioned from an old knitting needle.

Then, using the open tuner in the chassis on the bench, I explained how the biscuits were held in the turret and rotated by the channel selector knob. Next, I pointed out the access hole in the front of the tuner and showed how the slug was adjusted in situ.

Finally I added a note of warning about jammed slugs and selector knobs, with the advice to leave well alone if these troubles were encountered.

Did I get it across? I couldn't be sure right then, although the reaction seemed favourable. Only time would tell.

END OF THE STORY

It was nearly a week before I saw the lady again. then she came bursting into the shop full of thanks and goodwill on her brother-in-law's behalf. It seemed that the project had been 100 p.c. successful; the knobs had come off easily, the various holes were nicely in line and the slug had turned freely. it had taken only a few minutes to get the channel lined up for a perfect picture, and in plenty of time for the opening program.

All of which, I am sure any fellow serviceman will agree, must rate as some kind of a record. There are not many customers, of either sex, that I would trust to undertake such a job, even where the instruction could be given first hand. There are fewer still I would trust to convey such information, accurately, to a third person. I offered my sincere congratulations to the lady concerned.

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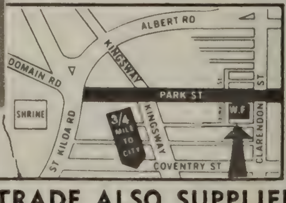

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A TWO BAND SHORT-WAVE CONVERTER

In our April issue we described a short-wave converter covering 6 to 19 megacycles. This month, we describe how to achieve greater coverage by adding a second band to cover lower frequencies and moving the present band slightly. The overall coverage is from 2.3 to 20 megacycles.

By John Davidson

THE circuit is basically the same as before. However, provision for band switching makes the circuit look a little more complicated. Don't let this deter you from building it, though.

Switching requirements call for a 4-pole, 3-position switch and, in this application we recommend the "Jabel" type. An "Oak" type switch could be used, but this would normally contain two wafers, making it difficult to accommodate without shortening the spacers between the wafers.

Both the primary and the secondary windings of the aerial coils are switched, but only the secondary tuned winding of the oscillator coils are switched. The oscillator primary windings are simply connected in series.

Some reduction in switching functions and wiring is achieved by this means although this is not without its complications. Due to linkage which it creates between the two oscillator coils, used and unused, some absorption, or "suck-out" of oscillator signal is inevitable.

Thus, when switched to the high band (Band 2), the low band secondary coil winding will resonate with the associated trimmer and stray capacitance, at a frequency within the limits of the high band. This absorption will be evident by a drop in oscillator injection at the particular frequency, causing reduced sensitivity.

A simple way to prevent this is shown in the circuit. A short circuit is switched across the Band 1 oscillator secondary winding when Band 2 is selected.

As in the single band version, the aerial is left permanently connected to the converter aerial input and is switched directly to the converter output and broadcast receiver input. The output winding of the coupling transformer does not have any noticeable effect on reception over the broadcast band.

The coils used in the single-band version will have to be modified slightly due, firstly, to the need to raise the upper limit of this present band and, secondly to the added capacitance in the wiring. The details for both the modified coil (now Band 2) and the new Band 1 coil are contained in the accompanying diagram.

A change has been made in the position of the trimmer capacitors. These are no longer connected across the tuning capacitor sections, but must now be switched with the particular coils to which they belong.

We have allowed for these to be positioned between the coil bases with the adjusting screw heads accessible from above the chassis. In order to fit the space available, the trimmers will need to be of the small rectangular type such as the Ducon CWA. The range of these trimmers is 5-55pF.

Provision has again been made for either balanced or unbalanced aerial feeders. The former method has the advantage that the feed line does not form part of the signal pick-up system, thus reducing considerably the amount of local man-made noise arriving at the aerial terminals.

To provide for balanced input we have simply wired the normally earthed ends of the aerial coil primary windings to a third terminal on the front panel. This additional terminal is designated "A2" while the normal terminal connected via the switch to the aerial windings is designed "A1". The earth terminal allows the usual unbalanced inverted-L aerial system to be used simply by connecting terminals A2 and E together with a wire link.

We have provided a built-in power supply with the converter but those wishing to save on cost could, in many cases, obtain the power needed from the receiver into which the converter will feed. This latter would depend on the receiver power supply being able to deliver an additional 15 milliamps of high tension and 0.23 amp heater current without causing significant temperature rise in the transformer.

If such an external power supply is used, the point to feed the HT to the converter is at point "A" on the circuit. Omitting the power transformer, the two silicon diodes and the two 50uF capacitors, the HT is fed via the 1K resistor and 8uF capacitor. The heater line of the converter should not be earthed if it is powered from the receiver, as in most cases the line will be earthed in the receiver and additional earthing may result in a short circuit.

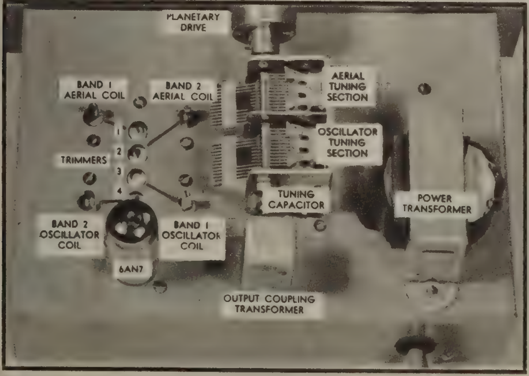
The power supply uses a small general purpose power transformer (Ferguson type PF2235 in our case) having a 6.3V heater winding and a center tapped 150V (75V per side) high tension winding. One of the 75V windings is also tapped at 25 and 50V.

In this circuit the transformer is used as a single winding 100V unit working into a conventional voltage doubler circuit. The 100V winding is made up from all the untapped 75V winding plus the 25V portion of the tapped winding. At the relatively light loading presented to the voltage doubler circuit, the HT is about 250V.

The dial and drive assembly comprise a 10-to-1 reduction unit, pointer, knob, dial card and perspex cover panel.

The tuning capacitor is a standard miniature two gang type. The front section is used for the aerial tuning and the rear section for the oscillator tuning.

The coils are positioned in a similar manner, in that the aerial coils are towards the front near the aerial input



As shown at the top of the page, the general appearance of the new converter is very similar to that of the April issue. At left is a coded view from above the chassis, showing the placement of the major components.

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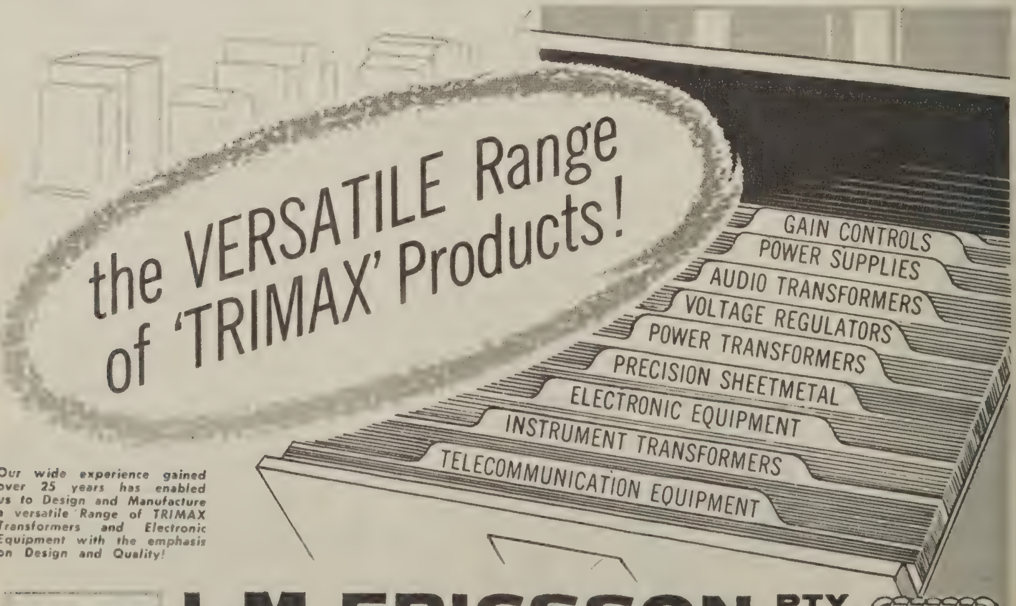

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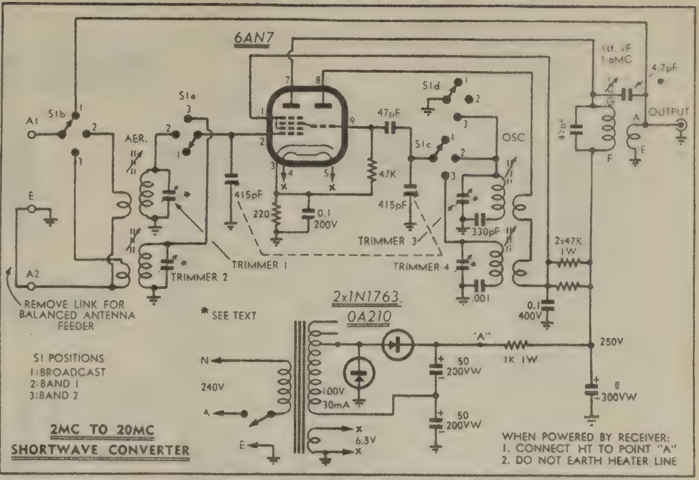


The main difference between this and the previous circuit is the additional set of coils and the switching necessary to accommodate them. Note also the addition of a small top coupling capacitor to the 1.6MC IF transformer.

terminals while the oscillator coils are towards the rear and close to the valve socket.

As shown in the photographs, the associated aerial and oscillator coils are placed diagonally opposite each other. This minimises coupling between them and the possibility random injection over and above that designed into the converter valve.

All four coils are wound on ⅜in diameter plastic formers (two pre-grooved and two plain) fitted with chassis mounting bases and adjustable iron cores. The formers will need to be shortened by about ⅛in to allow them to clear the bottom of the chassis.

The Band 1 coils are wound on plain formers using 26B&S or 27SWG enamelled wire. Both windings are close-wound and spaced 1/16in. The Band 2 coils are wound on pre-grooved formers using 22SWG enamelled wire for all windings. A layer of thin plastic insulating tape over the secondary (larger winding) will allow the primary winding to be interwound between turns of the secondary winding without fear of breakdown through the enamel.

The changes needed to convert the single band unit coils to Band 2 of this unit, are covered in the coil data. This is relatively simple, involving removal of one turn in each case.

Details of the Band 1 windings and correct phasing of the connections are also given. One particular phasing precaution is the series connection of the two oscillator primary windings. If the connections are incorrect the circuit will not oscillate on one or both bands.

The coil data are designed to provide coverage from 2.3MC to 7.3MC in Band 1 and from 6.6MC to 20MC in Band 2. This is a similar coverage to that found in conventional triple wave receivers, and is about the best compromise possible with two bands and normal tuning ratios.

However, some readers may be interested in the 1.8 to 1.86MC amateur band and/or the University of N.S.W. transmissions on 1.75MC. In this case the coils would have to be modified either on the basis that both bands would be altered so as to preserve the overlap, but restricting Band 2 to an upper limit of about 16MC, or by leaving Band 2 as is, but leaving a gap between the two bands from about 5.4 to 6.6MC.

To shift band by this amount we suggest the folowing modifications:

Aer. Pri.	11T
Aer. Sec.	31T
Osc. Pri.	9.5T
Osc. Sec.	22.5T

To shift Band 2 so that it overlaps Band I we suggest the following modifications:

Aer. Pri.	3.5T
Aer. Sec.	10T
Osc. Pri.	5T
Osc. Sec.	9T

The above figures are approximate, but should be adequate in conjunction with the adjustable iron cores. The spacings between the windings should be retained as specified.

The broadcast aerial coil serves as an output coupling coil by using the original secondary as a primary winding connected into the plate circuit of the 6AN7 hexode section. This new primary winding, usually marked "G" and "F," is made to resonate at 1600KC by connecting a capacitor across it and peaking the ferrite slug. The original primary winding, usually marked "E" and "A" (or "P" and "B"), will function as a secondary to provide a link coupling to the receiver aerial input circuit. The terminals should be connected as shown on the circuit.

This coil was originally specified as a standard broadcast aerial coil. Subsequent experiments indicate that there is some difference in performance between different grades of coil. In the miniature types it would seem wise to avoid the very cheapest versions but, on the other hand, there may be some physical problems in accommodating the very high gain versions housed in the larger cans.

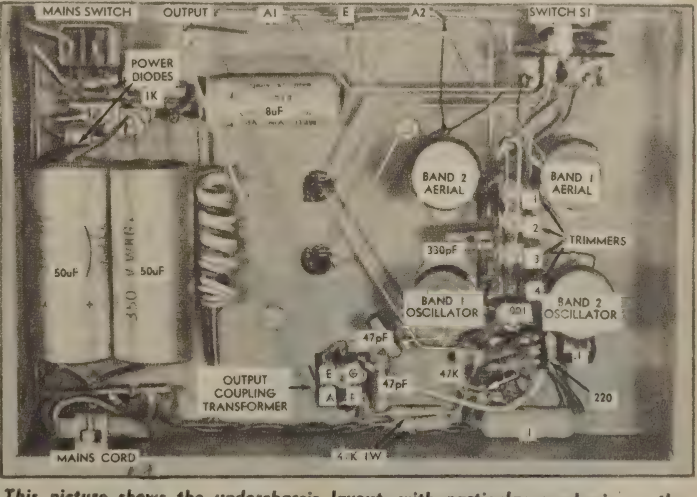
More important, at least in the case of the miniature types, seems to be the desirability of fitting a small value "top coupling" capacitor between the two windings, as recommended by the manufacturers when the coil is used in its intended mode. A value of about 4.7pF would appear to be about right, and is shown on the circuit. This may broaden the response of this transformer, but is hardly likely to effect the overall selectivity, which depends mainly on the second IF amplifier system.

The original chassis accommodates all the components necessary for this version, allowance having been made for the two additional coils, larger switch, and the trimmer capacitors when designing the single band converter.

Looking at the under chassis photograph, at the top from left to right will be seen the mains on/off switch, coaxial output socket, input terminals, and the band change switch.

The left-hand side of the chassis accommodates the power supply with the mains input terminating on three terminals of the four-terminal tagstrip at the bottom of the photograph. The remaining terminal anchors the common pigtails of the two 50uF capacitors while the other ends of these terminate on two terminals of the five-terminal tagstrip near the mains switch. Both power diodes, the 1K decoupling resistor, and the 8uF filter capacitor also terminate on this tagstrip.

The output coupling coil is positioned



This picture shows the underchassis layout, with particular emphasis on the placement of the coils and trimmers. Note also the orientation of the valve socket. Wiring associated with the tuned circuits should be short and direct.

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16/FP.58

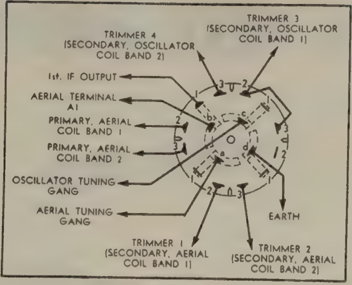
to the lower centre of the chassis with the pins of the tuned winding nearest the valve socket which is to the right. The valve socket is orientated with the gap in the pins toward the output coil, or more explicitly, in the direction of the arrow.

The four coil bases with tuning slugs are screwed in position between the valve socket and the band change switch in preparation for holding the coil formers, which can be connected into circuit last of all.

Positioned vertically between these bases are the four trimmers which are held together side by side, soldered to heavy gauge tinned copper wire which, in turn, is soldered to two lugs screwed to the chassis.

These particular small trimmers have the usual two tags at either end as well as a tag in the centre which contacts the adjusting screw which, by the way, is insulated from both plates. (Most trimmers have only two tags and the adjusting screw contacts the outer plate which is wired to chassis). We have placed the four trimmers side by side with the outer plate tags to the same end, then soldered all four outer plate tags and centre tags to two lengths of tinned copper wire.

This bank of trimmers was then positioned (strapped tags to the left) over four 5/16in dia. chassis holes, and between two bent-up solder lugs. Final anchoring is done by soldering both lengths of copper wire to the solder lugs at both ends.


TRIMMER 4 (SECONDARY, OSCILLATOR COIL BAND 2)
TRIMMER 3 (SECONDARY, OSCILLATOR COIL BAND 1)
1st. IF OUTPUT
AERIAL TERMINAL A1
PRIMARY, AERIAL COIL BAND 1
PRIMARY, AERIAL COIL BAND 2
OSCILLATOR TUNING GANG
AERIAL TUNING GANG
EARTH
TRIMMER 1 (SECONDARY, AERIAL COIL BAND 1)
TRIMMER 2 (SECONDARY, AERIAL COIL BAND 2)
1
2
3
a
b
c
d

Use this switch diagram in conjunction with the circuit and the coil data below.

Although all components are bolted to points on the chassis, it is not wise to rely on these for continuity of circuits, particularly at radio frequencies. We recommend that tinned copper wire of 16 or 18 gauge be soldered between the various components. One length was run from the output socket and earth terminal to the trimmers and another from the trimmers to the valve socket, valve spiggot, a solder lug under a tuning gang mounting bolt and the can of the output coupling coil.

It remains now to complete the point to point wiring, most of which can be done with tinned copper wire for mechanical stability. The presentation of a switch wiring diagram and the numbering of the trimmers, in order, from the front panel will aid in the interconnection of components.

When the wiring is complete the converter can be switched on and connected to a broadcast receiver via a length of shielded cable for a trial run. It will help if a service oscillator is available to establish the correct tuning range although it is by no means essential. In any case it is a good idea to start alignment with all iron dust cores set about half way into the coils and the trimmers in their mid position.

As a first step the broadcast receiver should be tuned to quiet spot on the dial near 1.6MC and the iron core in the converter coupling coil adjusted for maximum noise level or maximum signal strength if a short-wave signal is available at this stage.

It should be possible to obtain a double peak in signal, one as the slug moves into the winding and another as it moves out the other side. If a single peak occurs then the coil may not be peaking and the 47pF parallel capacitor will need to be increased. If no peak is apparent then it could be necessary to decrease this value. The above value should suit most makes of coils.

It may also be a good idea to check the adjustment of the broadcast set aerial trimmer, to make sure that it is providing maximum gain at 1.6MC. If there is an RF stage this trimmer can be checked also.

Because the converter is enclosed in a metal case, all alignment must be carried out with either a metal plate across the bottom of the chassis or with the chassis on top of the case in order to simulate the effect of placing the unit within the case.

Before attempting to align the converter it would be wise to mark, on the upper side of the chassis, the cores and trimmers with their band and function.

(Continued on page 71)

PARTS LIST

- 1 Standard small instrument case, panel and chassis, 9in x 6½in x 5½in.
- 1 Power transformer — 240V primary to 6.3V at 1A, 100V at 30mA (see text).
- 1 2-gang tuning capacitor, 415pF.
- 1 Planetary vernier drive, 10 to 1 reduction.
- 1 Dial scale assembly to suit.
- 1 4-pole, 3-position switch (see text).
- 1 Mains on/off toggle switch, panel mounting.
- 1 Broadcast aerial coil.
- 2 ¾in pre-grooved coil formers.
- 2 ¾in plain coil formers.
- 4 Bases and iron dust cores to suit above.
- 2 Power diodes, 400PIV. Type 1N1763, OA210, 1N3194 or sim.
- 1 6AN7 valve.
- 1 Miniature valve socket.
- 3 Terminals; 2 red, 1 black.
- 1 Coaxial socket.

RESISTORS.

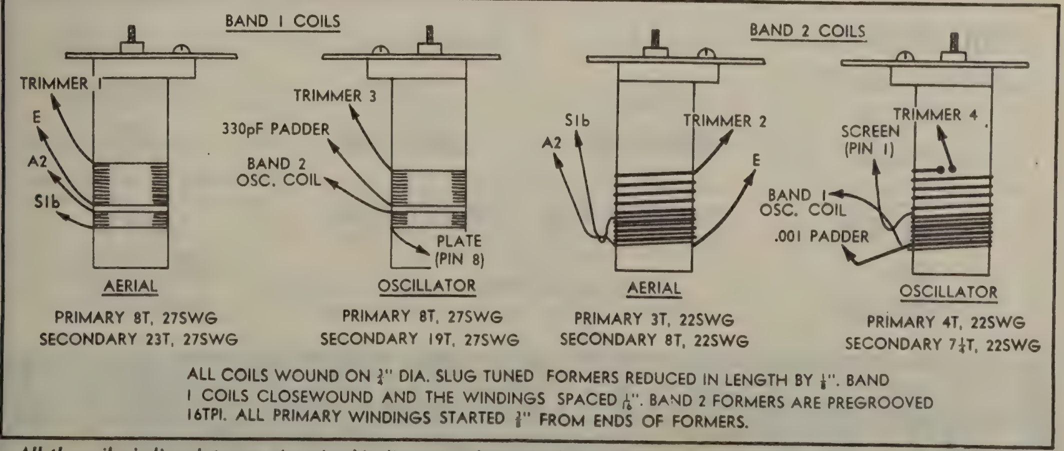
- 2 47K 1 watt.
- 1 47K ½ watt.
- 1 1K 1 watt.
- 1 220 ohms ½ watt.

CAPACITORS.

- 2 50uF 200W tubular electrolytic.
- 1 8uF 300W tubular electrolytic.
- 1 0.1uF 400V paper or plastic.
- 1 0.1uF 200V paper or plastic.
- 1 .001uF 200V mica or plastic.
- 1 330pF 200V mica or plastic.
- 2 47pF 200V mica or plastic.
- 4 5-55pF trimmers (see text).

MISCELLANEOUS

Knob; Tagstrips—1 x 5-pin, 1 x 4-pin; Power cord and plug, 2 rubber grommets, enamelled wire 22 SWG and 27 SWG or 26 B&S, nuts, bolts, solder, hookup wire; 18 gauge tinned copper wire .



AERIAL
PRIMARY 8T, 27SWG
SECONDARY 23T, 27SWG

OSCILLATOR
PRIMARY 8T, 27SWG
SECONDARY 19T, 27SWG

AERIAL
PRIMARY 3T, 22SWG
SECONDARY 8T, 22SWG

OSCILLATOR
PRIMARY 4T, 22SWG
SECONDARY 7¼T, 22SWG

ALL COILS WOUND ON ¾" DIA. SLUG TUNED FORMERS REDUCED IN LENGTH BY ⅛". BAND 1 COILS CLOSEWOUND AND THE WINDINGS SPACED 1/16". BAND 2 FORMERS ARE PREGROOVED 16TPI. ALL PRIMARY WINDINGS STARTED ⅜" FROM ENDS OF FORMERS.

All the coil winding data are given in this diagram, which should be studied in conjunction with the circuit and the switch diagram above.

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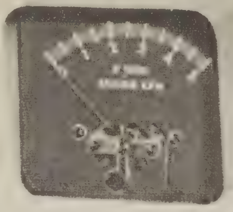

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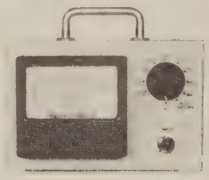
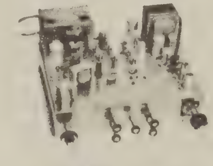
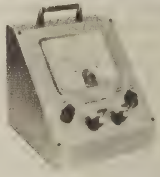


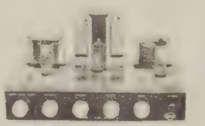
Transistor m/v Meter



1964 TV Receiver



Impedance Meter



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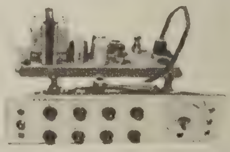

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5 Std. Series, 35 Watt.
6 Std. Series, 50 Watt.
7 Playmaster 102.
8 Playmaster 103.

HI-FI MONAURAL

9	H-Fi	3
10	Mullard	3-3
11	Mullard	5-10
12	Mullard	5-20

HI-FI STEREO

13	Basic	2
14	Mullard	2-2
15	Mullard	3-3
16	Mullard	10-10
17	Philips Twin	10
18	Playmaster Twin	10
19	Playmaster Twin	17
20	Playmaster Unit	1
21	Playmaster Unit	2
22	Playmaster Unit	3
23	Playmaster Unit	4
24	Playmaster	101
25	Playmaster	105
26	Transistor	1W
27	Transistor	2W
28	Transistor	5W
29	Transistor	10W

P/A UNITS

30	Standard	10W
31	Standard	25W
32	Standard	35W
33	Standard	50W
34	Standard	100W
35	Transistor	10W
36	Transistor	30W

TAPE UNITS

37 Mono No. 3
38 Mono No. 4
39 Stereo
40 Steereo Adapter.
41 Stereo Phone Amp.

PREAMPLIFIERS

42	Transistor Mono	
43	Transistor Stereo	

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44	Playmaster No. 8	
45	Playmaster No. 9	
46	Playmaster No. 10	
47	Playmaster No. 104	
48	4-Channel Mixer	
49	Philips Magnetic	3V
50	Mullard	2V
51	Mullard	3V
52	Transistor Mono	
53	Transistor Stereo	

CONVERTERS

54	S/W Batt.	1
55	S/W Batt.	2
56	S/W A.C.	1
57	S/W A.C.	2
58	All Wave A.C.	2
59	Transistor 2 Band	
60	50 MC/S	
61	144 MC/S	
62	50-144 MC/S X'Tal Locked	
63	D.C.-D.C.	40W
64	D.C.-D.C.	60W
65	D.C.-A.C.	40W

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67	5in Wide Range	C.R.O.
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69	R/C Bridge	
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71	Electronic Stethoscope	
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73	Sweep Marker Generator	
74	Pattern Generator	
75	Diode Noise Generator	
76	G.D.O. Adapter	
77	Standard Audio Oscillator	
78	1962 Wide Range Audio Oscillator	
79	Transistor Wave Meter	
80	Transistor Signal Tracer	
81	Transistor Pattern Generator	
82	Transistor Tester	
83	Valve and Transistor Tester	
84	Millivoltmeter	
85	Distortion, Noise and Millivoltmeter	
86	Mullard Tachometer	
87	"R" Decade Box	
88	"C" Decade Box	
89	Electronic C.R.C. Switch	
90	Geiger Counter	

RECEIVERS

91	DXERS (Batt.)	1
92	DXERS (Batt.)	2
93	DXERS A.C.	2
94	DXERS A.C.	3
95	DXERS 3 Band	3
96	Little General 1961	
97	Interstate	5
98	1962 Stereogram	
99	Fremodyne	4
100	Amateur RX	
101	Transistor	1
102	Transistor	2
103	Transistor	3
104	Transistor	4
105	Transistor	5
106	Transistor (R.F.)	7
107	Transistor	8
108	Transistor 3 Band	8

TRANSMITTERS

109	V.F.O.	1962
110	Remote V.F.O.	1963
111	144 MC/S A.M.	TX
112	144 MC/S S.S.B.	TX
113	1962 S.S.B.	TX
114	144 MC/S Linear Final	

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" "	V.U. Meter	52/6
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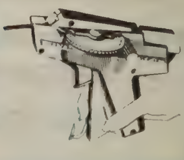

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Forum

As much as we have tried to round it off, readers still seem to want to discuss that much belaboured paragraph in "Answer Man," so further brief acknowledgement seems to be inevitable. This is followed by further comment on last month's letter about high fidelity television.

By W. N. Williams

DURING the month, three or four more letters came to hand, putting views as to what happens when signal from a distant radio station reaches a ferrite rod aerial prior to its connection to any other circuit elements. Is it true to state, as we originally did, that voltage and current is induced in the winding?

Having challenged the original statement, most correspondents seem now to have conceded that the to-and-fro movement of electrons, from end to end of the conductor, under the influence of the incident alternating field, can legitimately be considered as a current flow.

The distinction between this and the current component which flows under conditions of external loading has been clarified, as also has use of the conventional equivalent circuit and formulas to evaluate the inductor as portion of a tuned circuit.

However, the matter has not ended here and writers have gone on to develop views about fundamental things in letters which are at variance one with the other, which contradict what the writers thought we meant and didn't say . . . and so on.

Much of this further discussion revolves around the three letters "emf."

WHAT IS EMF?

What exactly do we understand by emf? Are the everyday definitions of it adequate or otherwise? How do such definitions apply to a coil suspended freely in a radiation field? "Do they apply at all?" asks someone else.

You can't pursue such questions far without becoming involved in speculation as to why electrons behave as they do. Why are they subject to a force when there is movement relative to a field? Why, in a generator, are electrons spurred into such activity, when they pass through a fixed field which, itself, does not appear to contribute energy?

What are electrons anyway?

I say this, not to confuse the issue, but to indicate where the interlocking discussions have led as I have gone through each new letter with our Technical Editor. It becomes apparent that, to resolve the arguments would require a symposium with all the correspondents present, rather than relying on a long sequence of exchanges published at the rate of one a month!

Come to think of it, here's a ready-made topic for an I.R.E.E. Discussion Night!

Nor would it be at all inappropriate. It is possible for people engaged in the electronics field to be quite expert in terms of application, while rather hazy about the physics behind the formulas.

And the remark goes for us, as much as for anybody!

Just one more thing before we change the subject: A number of correspondents have stumbled over the equivalent circuit which classically represents a coil, such as we have been discussing, as an inductor in series with an AC generator, with nothing connected across the combination.

They have looked at the circuit and assumed that no current can flow through the combination unless some kind of a load is connected across the outer terminals, thus apparently contradicting our original statement. It didn't, of course, because we had in mind only the internal electron movement in the coil which the AC generator is intended to symbolise.

In fact, the equivalent circuit picture can be developed in a most interesting fashion: The AC generator connected to one end of the inductor is better considered as a "lumped" generator which is really equivalent to a large number of generators distributed along the inductor.

More explicitly, each infinitesimal piece of conductor exposed to the magnetic field constitutes a generator so that, in a sense, the total inductor is an infinite sequence of generators, acting as "electron pumps" to pump electrons alternatively from one end of the series chain to the other.

This concept removes any difficulty about visualising current through, and potential across, the unloaded inductor.

But, of course, the lumped inductor is easier to draw and adequate for calculations involving external load conditions.

So far so good, until somebody — in this case a disturbing combination of a correspondent and our Technical Editor — insists on taking a closer look at the resistance component of the wire with which the coil is wound.

Would this effect the voltage across the inductor in its unloaded condition and, if so, would this contradict Lenz' Law?

This leads naturally to the question as to whether Lenz' Law concerns itself with conductor resistance and whether, for that matter, it applies for a radiation field.

And what would be the situation if the coil were wound with material exhibiting extremely high resistance . . . say nylon thread? Would there be a voltage across it?

Aw hec!

HI-FI TV AGAIN

To change the subject, a reader from Melbourne takes up again the matter of high (visual) fidelity television. After some complimentary remarks about "ELECTRONICS Australia" he comments on two aspects of the letter discussed in our last issue:

"Until recently, I built my own sets and had available to me the necessary equipment to obtain optimum results. However, for health reasons, I decided recently to provide my family with a set that could be serviced, if necessary, by a regular serviceman.

"Accordingly, I spent a considerable time going over the circuitry of current models. What soon emerged was that two types of sets are placed on the market by reputable firms. Unfortunately, these have been given the labels of 'local' and 'fringe' but inspection showed that the differences were far greater than this.

"Apart from having an extra stage of IF, the so-called fringe models had much more sophisticated circuitry. As examples, the loop gain of the AGC was higher, the video detector was separated from the audio detector but, most important, the black level was clamped.

"These all resulted in a better picture, independence of brightness and contrast controls and non-variation of the black level, even between stations.

"I duly bought a set of the so-called 'fringe' variety, even though I live within 15 miles and line of sight of the transmitters.

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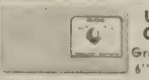

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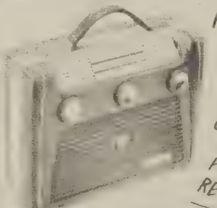

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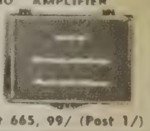

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viewing and never touch the controls thereafter, except to change channels.

"By clamping, the black level can be set by the so-called 'brightness' control (which would be better named 'black level') and the white level set by the so-called 'contrast' control, with a minimum of interaction.

"I understand that this particular model is used by the A.B.C. as a standard of comparison.

"It seems a pity that the label 'fringe' has been applied to these sets, as many of their features are primarily of interest to metropolitan users, where the signal-to-noise ratio is high. However, such is competitive pricing!"

All this is so straightforward that it calls for no elucidation in the technical sense. However, the point which our correspondent raises is interesting, even if the facts behind it are not entirely novel.

Who, in a strong service area, would be likely to select a "fringe" receiver, unless they were alerted to look for its not-so-obvious qualities?

Again, how would a manufacturer go about marketing a "fringe" receiver in a metropolitan area on the basis which our correspondent has outlined?

Of what use would it be to call it "high fidelity" and so on, when all the adjectives (and superlatives) have seemingly been spent on quite ordinary receivers?

And of what use would be a listing of technical features? Others could likewise include technical jargon in advertisements meaning very little but sounding no less impressive to the uninitiated!

Perhaps the most we can hope for is a slow process of education in which people who really care about visual quality can be encouraged to think in terms of more sophisticated circuitry, irrespective of the name or adjective under which it is found.

Turning to the second point in the discussion, our correspondent goes on:

"I think you have made the point about what constitutes black level. On a test pattern, both the station engineer on his wave form and the viewer with his brightness control can set up black level.

"But when it comes to program material, particularly film, the story is very different. Some station engineers do lower the black level (or turn up the brightness, if you prefer the term) as is evidenced by their running into 'whiting out' of the picture when a commercial follows hard on the heels of a night scene on film.

"However, my impression is that there is less of this going on than in the past.

"A point that has interested me, since Channel 0 came on the air in Melbourne, is the different pattern of black-to-white graduation transmitted by this station as compared with the older stations. I think that this is gamma coming to light.

"I think that some German television receiver circuits include a means of varying gamma in the video detector circuit.

"Finally, in regard to overscanning, I am inclined to agree that the overscan on the average commercial set is excessive and, in some cases, there is no provision for reducing it.

"I am sure that your earlier correspondent will be very happy with the introduction of the 25-inch picture tube, as he will now be able to read the edges of the titles—provided, of course, that the station transmits them for him."

Most of the above is fairly straightforward and can pass without comment, except perhaps for the reference to 25-inch picture tubes.

A few months ago, quite a few readers snarled at the then current advertising campaign which seemed to imply that, with the introduction of a 25-inch tube and for the first time, it had become possible to see the whole picture.

In fact, of course, it is possible to see the whole picture — and in the right aspect ratio — on a tube of any size, provided the scanning adjustments are set to keep the picture within the limits of the screen and mask.

In the days when we played with such things, I've had complete and properly proportioned pictures small enough to fit on the face of a 1-inch C.R.O. tube!

There have been two main reasons why overscan has become the accepted thing.

One arises from the fact that the standard TV aspect ratio is 4/3, whereas most picture tubes have had an aspect ratio nearer 5/4. This meant that they were too high for their width, compelling one of the following comprises: (1) a neatly fitting but slightly distorted picture; (2) a non-distorted picture of the correct width but less than the full height of the tube; and (3) a non-distorted picture the full height of the tube but spilling over each side.

The second problem has to do with the tendency of the picture to shrink within the mask area with aging valves or diminished line voltage. Rather than have this happen, manufacturers designed their sets for generous overscan, so that the picture could always be expected to fill the mask.

It is important to realise that this can still happen with 25-inch tubes or even bigger ones, for that matter. The aim of seeing the whole picture, without distortion, will only be met in receivers where the tube is accurately masked to an aspect ratio of 4/3 and where the internal circuitry employs automatic control of picture dimension to hold the limits accurately to the mask limits. ■

PLAYMASTER 110 TAPE AMPLIFIER

(Continued from page 49)

Before closing, a few words would seem to be in order regarding a suitable case or console for the Playmaster 110 tape system. As the photograph shows, the prototype unit has been fitted into a fairly large console, for general use around our laboratory and office. The deck, amplifiers and power unit are fitted into the top section, with the small internal speakers in enclosures below and the remainder of the console used for tape and disc storage. Heavy-duty spherical castors make the console readily moveable.

While a few readers may wish to build up a console similar to our own for their system, we imagine that most will want to build it into a fairly small case to facilitate transport. To these people we would make the suggestion that they make the case similar to the top of the prototype console, with a removable lid, and with the speakers fitted to the sides of the case — immediately beneath the deck and each side of the power unit.

The resulting recorder will be by no means small, but quite moderate in size and capable of transport without undue difficulty. Considering the performance of the system, this degree of compactness will probably be quite acceptable.

We leave to individual readers the details of the case design, choice of materials and finish, as these matters will depend a good deal on taste, ability, costs and intended application. ■

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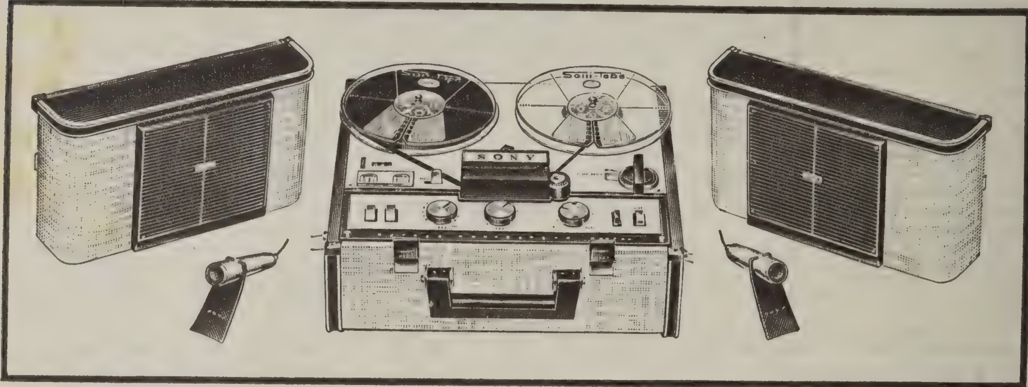

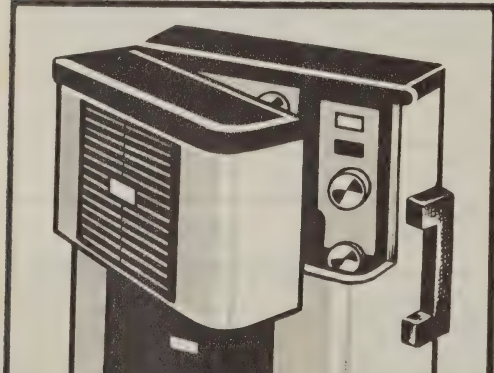

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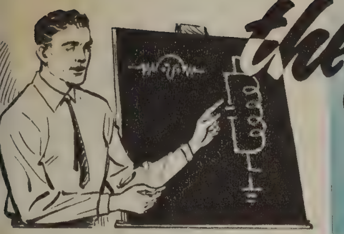


the "Answer Man" Explains

University Radio Station

The opening question, this month, indicates a thirst for knowledge, not merely from the pages of this journal, but from the lectures currently being broadcast by the University of N.S.W.

I have heard that ordinary superhet receivers can be modified quite simply to receive the University of N.S.W. transmitter in Sydney. Is this true and what has to be done?

It is indeed true that many domestic receivers can be modified, but how easily or how successfully depends on the receiver itself. Most "amenable are ordinary 4 and 5-valve superhets. The idea actually puts to good use a characteristic of the superhet receiver, which is commonly regarded as a limitation.

Let's explain what we mean.

Consider the case of an ordinary superhet with 455KC IF channel, tuned to receive a station transmitting on 1000KC. The aerial input circuit would be tuned to accept the 1000KC signal, while the local oscillator would be operating at 1455KC.

The locally generated signal on 1455KC beats with the incoming 1000KC signal to produce a difference frequency of 455KC. This latter is accepted by the intermediate frequency (IF) channel, which amplifies it and passes it to the detector. Here the audio component is isolated, to be passed in turn to the audio amplifier section and thence to the loudspeaker.

The tuning system of the receiver is so arranged that the oscillator is always 455KC above the frequency to which the aerial input circuit is tuned and all incoming signals go through the same process of conversion to the intermediate frequency.

It is interesting to note, however, that, for any given setting of the local oscillator, there are two possible signal frequencies which can produce the intermediate frequency—one lower than the oscillator by the requisite amount, the other higher.

Reverting to the figures quoted earlier, it was mentioned that an intermediate frequency of 455KC would be produced by the combination of an incoming signal at 1000KC and a local oscillator frequency of 1455KC.

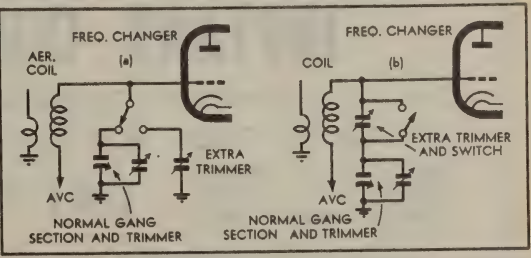
But a signal at 455KC could equally result from a combination of the oscillator frequency at 1455KC with an incoming signal of 1455+455, equals 1910KC.

The fact that signals higher than the oscillator frequency are not normally heard in an ordinary broadcast band superhet is due to the selectivity of the tuned aerial input circuit, which accepts the lower frequency signal but rejects the higher.

This is the way we normally want things to be—except when bent on some circuit trickery to receive the N.S.W. University radio station!

This station transmits on a frequency of 1750KC, which is just beyond the high frequency limit of the usual domestic broadcast receiver. With the dial set to the limt of its travel, the aerial input circuit won't quite make 1750KC, while the oscillator won't quite reach 2205KC.

But the oscillator does pass through 1750—455, equals 1295KC. It does so when the tuning dial is set to receive a signal frequency of 840KC — just near the middle of the broadcast band.



Alternative methods of resonating the aerial coil to 1750KC.

So, by the simple expedient of tuning the receiver to 840KC or thereabouts, its oscillator is put on the right frequency to heterodyne the University station and produce a resultant signal to penetrate the 455KC IF channel.

The fact that the signal is not commonly heard when receivers are tuned over this part of the band is a tribute to the effectiveness of the tuned aerial input circuit.

Render it less effective and the station may become audible. With a bit of luck, it may be possible to hear the station by doing no more than coupling an aerial wire directly to the signal grid of the mixer valve, while tuning around 840KC.

More commonly, however, it is necessary to "get at" the aerial tuned circuit to bring its resonance to 1750KC or thereabouts.

For example, a slide switch may be installed to disconnect the aerial section on the tuning capacitor from the rest of the circuitry. This may or may not leave the aerial trimmer in circuit, depending on where it is mounted but, either way, the untuned aerial coil will tend to favour the 1750KC signal which it previously rejected.

If the University station signal is still not received well enough, steps can be taken to bring the aerial circuit to exact resonance at 1750KC.

One scheme is to leave intact the lead from the aerial coil to the signal grid, but break the connection to the relevant gang section and trimmer. A slide switch is now installed to restore the connection for ordinary broadcast reception, or, instead, to connect across the coil a variable trimmer. With the receiver tuned to 840KC, the trimmer can be peaked for optimum results from the University station.

Another scheme, as illustrated, is simply to wire an extra trimmer and shorting switch in series with the lead to the gang section and trimmer. The extra trimmer is peaked for best results from the University station, but shorted out for normal broadcast reception

Care should be taken to keep additional lead lengths to a minimum, to avoid introducing unnecessary extra capacitance into the aerial tuned circuit. Even so, it is likely that the broadcast band aerial trimmer will need to be repeaked for maximum response from stations at the high frequency end of the band.

Whether or not modifications of this nature are feasible depends a great deal on the design of the receiver. In older type valve receivers, there is usually plenty of room to instal a couple of extra wires and components and not much risk of doing the wrong thing.

However, we would hesitate to suggest operations of this kind on transistor sets, both by reason of their compactness and the danger of getting tangled up with the bias arrangements. Another point is that these receivers often use a tuned RF stage, so that two signal frequency circuits require to be "doctored" instead of one.

With such sets, it would seem much wiser to invest in a converter unit, avoiding the necessity for interfering with their internal circuitry.

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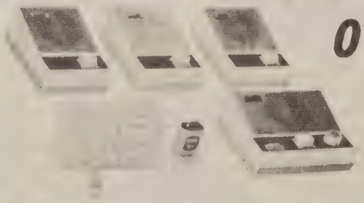

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What causes "motorboating" in an audio amplifier, and how may it be cured?

When a number of amplifying stages are fed from a common high tension supply, the impedance of the supply is common to all stages and if it is of appreciable magnitude, it will couple the stages together. The effect of this interstage coupling is to provide positive feedback between alternate stages and negative feedback between adjacent stages. Motorboating is the result of positive feedback between alternate stages.

Looking at it another way, let us visualise an output stage reproducing a sine wave, particularly at a low frequency. As the output valve receives appropriate signals at its grid, the plate current will go through a cycle of normal standing current rising to a peak, falling again to the standing current level, continuing to fall to a minimum, then rising again to the standing current level to complete the cycle. This signal, conveyed to the loudspeaker, will be reproduced as sound.

But let us take a look at the power supply driving this cycle. Ideally, it should continue to deliver exactly the same voltage throughout the entire cycle, in which case we would regard its internal impedance as zero. In practice it will be less than perfect and there will be some variation in voltage.

Thus, the voltage will tend to fall as the current rises, and to rise as it decreases. It is this voltage variation which causes the trouble, because it will be fed to the earlier stages operating from the same supply, be amplified by the succeeding stages, and appear at the grid of the output stage as a false signal.

When this signal is initiated in an alternate stage, say the first stage in a three-stage amplifier, its phase will be such as to constitute a positive feedback condition.

In a typical power supply smoothed by means of a low pass filter, the impedance of the supply will be approximately equal to the reactance of the output capacitor of the filter at the frequency under consideration. The impedance will increase as the frequency decreases, so it can be seen that the coupling between stages will be greater at low frequencies.

If we take a typical filter having an output capacitor of 8uF, we find that its impedance at 2cps (a typical frequency at which motorboating occurs) will be 10,000ohms. The stages of the amplifier connected to this supply would then be commonly coupled (at 2cps) by this 10,000-ohm resistance, and positive feedback, with its "motorboating" symptoms, could easily occur.

In an amplifier which has worked satisfactorily for some time before exhibiting motorboating symptoms, the probable cause of trouble would be the final capacitor in the power supply which, through aging, has decreased in value. Replacing the capacitor should cure the trouble.

A newly designed amplifier which motorboats when first switched on, however, might need more drastic measures to tame it. The first step might be to increase the value of the output capacitor in the power supply.

A capacitor of 100uF has an impedance of 800ohms at 2cps and, as such high value capacitors are easily available these days, a unit of 100uF or even higher value might, as a first step, be placed across the output of the power supply.

If this should fail to remove all traces of the trouble, the next logical step might be to decouple the plates and screens of individual valves from the HT line.

In a typical pentode amplifier valve this involves lifting the plate and screen supply resistors from the HT line and inserting a 47K resistor between the junction of these two resistors and the supply line. The common junction of the 47K resistor and the plate and screen feed resistor should be bypassed to chassis with an 8 or preferably 16uF electrolytic capacitor.

Another scheme often adopted to prevent motorboating is the reduction of the coupling capacitor values between valves in a resistance/capacitance coupled amplifier. This method limits the low frequency response of the amplifier, however, and has serious shortcomings because of this fact.

When considering the problem of interstage feedback due to common coupling through the HT line, it should be borne in mind that, while coupling between alternate stages produces positive feedback with obvious symptoms (motorboating), coupling between adjacent stages produces negative feedback and the results of this (loss of gain) are not so obvious.

In any well-designed amplifier, then, the power supply should have as low an impedance as can reasonably be obtained with available capacitors and interstage decoupling should be adopted as a matter of course.

SPACE GREASE

(Continued from page 11)

Gears work basically the same way. A small lubricating gear, made entirely of the metal-lubricant compound, meshes with the working gear.

Blending molybdenum disulphide powder, which will lubricate in ultrahigh vacuum, with tantalum and iron is one of the ways to produce the solid lubricant. Other combinations of lubricating powder and metal have been tested successfully.

Boeing is pioneering the research in the metal-lubricant field. When graphite's abrasiveness under vacuum was discovered, most researchers sought to spray a coating of molybdenum disulphide onto friction-bearing surfaces.

Up to now, however, spray-on lubrication has been effective for only a few minutes under punishing high-speed, high-vacuum conditions. In contrast, the metal-and-lubricant bands and gears will operate efficiently for long periods of time.

The metal-lubricant is not economically competitive with oil and grease for use in such equipment as cars. But Army and Air Force helicopters soon may use self-lubricating gears and bearings in rotor transmissions, to get away from the possibility that a bullet through the oil pan might put the 'copter out of combat action.

S/W CONVERTER

(Continued from page 61)

It is all too easy to upset the alignment of one band, whilst attending to the other.

Although alignment of the short-wave bands follows the same general principles as for the broadcast band, adjustment will, in general, tend to be more critical, particularly at the higher frequencies. There may also be some tendency for circuits to interact slightly, so that adjustment of an aerial trimmer (or slug) may also slightly detune the associated oscillator circuit. Unless this point is appreciated, accurate alignment may not be possible.

The usual trick, when aligning shortwave circuits, is to rock the tuning gang slightly across the signal being used, while adjusting the aerial circuits, comparing the peak of each sweep with that of the previous one.

If a service oscillator is available, alignment can be commenced by setting it to the lowest frequency to be covered by the particular band, then adjusting the oscillator slug so that this frequency is received with the tuning capacitor fully closed. The aerial coil slug may be roughly peaked at this time also.

Now set the generator to the highest frequency nominated for the band, and check that it is possible to receive this frequency, adjusting the oscillator trimmer slightly if necessary. When working on Band 2, there is a risk that a signal at the high frequency end may be received in two places on the dial, due to the image problem discussed at the beginning of the article. It is essential that the correct signal be chosen.

Due to the double conversion feature of this set-up, any image will be well removed from the true signal (approximately 3.2MC away) but may still force its way through if the signal is strong enough or if the (as yet) non-aligned aerial circuit should happen to favour it.

To avoid any ambiguity in this matter it is as well to seek out both signals and then choose the right one. This will be the one closest to the high frequency end of the dial.

Once the coverage of the band has been confirmed, it is a good idea to return to the low frequency end and then progress toward the high frequency end in .5 or 1MC steps, marking these points, in pencil, on the dial.

This done, the aerial slug and trimmer may be adjusted for maximum gain. The slug should be adjusted first, at a point slightly in from the extreme low frequency end of the band, say 2.5 or 7.5MC. The aerial trimmer should be adjusted at a point slightly in from the high frequency end, say 6.5 or 19MC.

It is a good idea to go over the alignment procedure a couple of times to make sure everything is just right. When you are quite satisfied, the dial calibrations may be marked in permanently.

If a service oscillator is not immediately available, regular signals will have to be used. Choose a steady signal, preferably near one end of the band, and adjust the appropriate slug or trimmer. Unless the frequency of the transmitter is known, there may be little point in touching the oscillator circuits, the aerial circuits simply being peaked for strongest signals.

The connection between the converter and the receiver must be shielded to prevent any pickup of signal at 1.6MC. For this reason also, a receiver with a built-in ferrite aerial may suffer from unwanted break-in, in which case the frequency selected for the first IF should be the quietest spot near 1.6MC.

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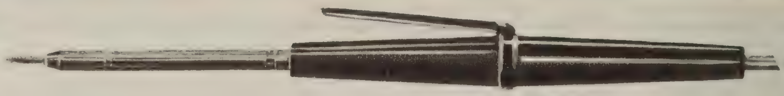

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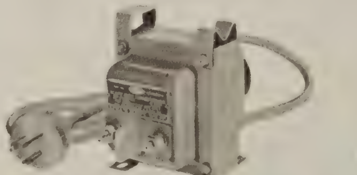

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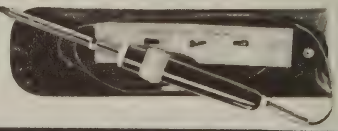

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MUSICAL SCALES AND TUNING

— in matter-of-fact electronic terms

The following article is based on a lecture delivered some time ago, by the Editor, to a meeting of the theatre Organ Society of Australia. Its aim is to assist men trained in "radio", who currently find themselves involved in the maintenance of electronic keyboard instruments. It presents something of the musical background to tuning, relates this to electronic terminology and comments on principles which might form the basis for portable electronic tuning instruments.

by Neville Williams

THERE is no need to emphasise to readers the number of electronic keyboard instruments which have come into use in recent years, ranging from monophonic "solo" instruments to full electronic organs. These all require their share of electronic maintenance and, from time to time, most of them need to be re-tuned as well.

Given a circuit and routine audio test gear, "radio" personnel can usually deal readily enough with the electronic problems. However, if the instrument needs subsequently to be tuned, either as a matter of course, or as a by-product of the electronic service, that is quite another matter. The serviceman may tackle it without any real assurance or understanding; more likely he will avoid the issue, pleading his lack of musical training.

Either way, he will wonder why he can't check tuning with a simple electronic instrument, just as he checks voltages, currents and waveforms with a meter and oscilloscope.

Perhaps he can — as we shall observe later in the article.

The tuning of conventional "acoustic" musical instruments has long been regarded as something of an "art," or a "gift" possessed by certain musicians and professional tuners. While, in fact, many of the alleged "mysteries" of tuning yield to quite routine mathematics, it is wrong to proceed to the other extreme and to write off tuning as a simple matter — merely one of adjusting certain notes to certain frequencies, as an audio enthusiast might understand the phrase.

To put things into perspective accurate tuning involves adjusting individual notes, in relation to one another, or to predetermined pitch standards or to both, within frequency tolerances which are far smaller than any encountered in even a high grade audio laboratory. If the requisite accuracy is not achieved, the instrument will sound "out of tune" when played, even to a non-critical listener.

In musical circles, a reference figure which if often quoted as a desirable order of tuning accuracy is to within 1/100 semitone or "one cent." This works out at just over .05 per cent of any given frequency, though some go so far as to claim that the order of achievement should more nearly approach .01 per cent.

Without debating these figures further at this point, either will serve to indicate the inadequacy of ordinary audio equipment as a musical frequency standard, in terms either of stability or dial calibration. A wide-band audio generator would be considered "rather good" if it had an absolute accuracy to within 1.0 per cent, let alone one twentieth or less of that figure!

Professional instrument tuners rely, not on instruments, but on the observation of very low frequency beats (or heterodynes) which occur between the notes comprising the musical scale.

Typically, they may begin by accepting one note as a reference, or setting it to exact zero beat with a tuning fork. In the latter case, the reference frequency is likely to be accurate to a fraction of a cycle in several hundred cycles. They then proceed to adjust all other notes in relation to this standard by listening to the beats between notes of their harmonics.

Proper interpretation of the beats can retain an accuracy, over the keyboard of a good instrument, of the requisite small fraction of one per cent. As a first requirement, any electronic tuning aid, which one might seek to devise must do likewise!

However, at a sophisticated level, tuning an acoustic instrument involves more than merely adjusting, to a high order of accuracy, a lot of unrelated strings, pipes or other forms of resonator. The exact character of each unit and its acoustic environment can have a subtle effect on the apparent pitch and quality of the note it produces. This may call for some basic modification to the resonator or a deliberate manipulation of its frequency to produce the desired sound sensation, when the note is sounded singly or within a chord.

The possible effects of temperature and humidity may also have to be taken into account.

In short, the tuning of a complex instrument, such as a pipe organ, a carillon or a piano of concert standard calls for a great deal of subjective judgment based on knowledge, skill and experience. This is the way it has always been and so it will probably remain, into the forseeable future.

Naturally enough, the frequency and precision of tuning is related to the quality and usage of the instrument concerned. Whereas a concert piano or a cathedral organ may be checked and adjusted every few days, suburban tuners, concerned with "suburban" instruments, work to much less exacting standards, even though their basic tuning procedures may be along similar lines.

As often as not, their problem is to tune a "tired" instrument to an accuracy, which will satisfy the owner or the group concerned, for payments no larger nor more frequent than is strictly necessary.

When it comes to keyboard **electronic** instruments, two quite different skills are involved. Not surprisingly, we find many professional tuners bauked by the electronic circuitry and, equally, many electronic servicemen bauked by tuning problems. To bridge the gap, individuals in the respective groups must either increase their skills or, in the case of electronic servicemen, supplement them with possible instrumentation.

The concept of tuning an **electronic organ** with instruments is validated by certain important considerations:

(1) The tones are (or can be) constant in terms of amplitude and frequency and immediately accessable as signal voltages to an oscilloscope.

(2) The frequencies are (or should be) more or less independent of ambient temperature and humidity so that no allowance for these factors need be made.

(3) The tone quality of individual notes is more uniform than in the average acoustic instrument, so that good tuning is more or less synonymous with accurate frequency adjustment.

In short, one can readily make a good case for devising an electronic tuning standard for use with electronic organs and by servicemen who, ordinarily, might find it difficult or impossible to tune an instrument by established techniques. If such an aid should prove valuable in other fields, so much the better.

* * *

However, before discussing the practicability of electronic aids, it is appropriate that we give some attention to the fundamental problem of tuning, from a purely musical viewpoint.

Behind our present musical scale, there is a great deal of tradition, evolution and argument. It is not our purpose here to debate the matter but simply to state the facts briefly in order to acquaint readers with the position as it is at present.

The subdivision of musical frequencies is based on the OCTAVE, which represents a 2:1 frequency relationship. Taking a musical note of any frequency, a second note of twice the frequency in cycles per second is said to be one octave above the first. Similarly, a note of half the frequency is said to be one octave below.

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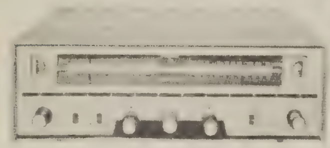

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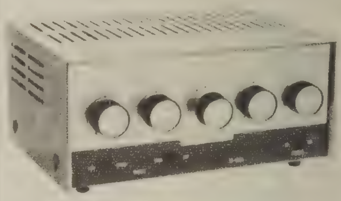

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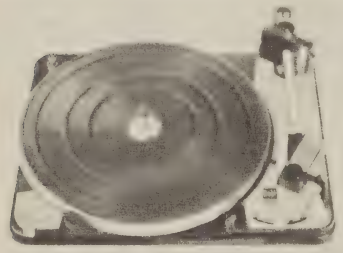

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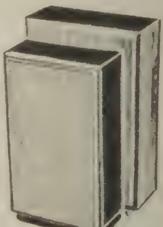

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grown to accept the principle that an octave divides most naturally into seven intervals, for which we use the terms TONES and SEMITONES. As the names imply, an interval or frequency difference of one tone is greater than that of a semitone.

To be more specific, the octave appears to divide most naturally into a SCALE comprising a succession of intervals in the following order: Tone, tone, semitone, tone, tone, tone, semitone. This particular and rather basic progression makes up what is known as the "Major Diatonic Scale."

Those who deal in musical terms might prefer to express the progression as a "first tetrachord" (tone, tone, semitone) separated by one tone from a second tetrachord (tone, tone, semitone). However, we are in danger of diverging into technicalities remote from our present purpose!

A great deal of argument has gone on as to the exact reason why we so accept certain critical intervals — or frequency ratios — as constituting a natural subdivision of the octave. In part, at least, it would appear to relate to the coincidence of prominent harmonics when certain notes are played together — notes which "harmonise." The harmonics may be present in the original tones or may, as well, be added by our senses.

Reasons notwithstanding, if a person accustomed to "Western" music is asked to sing a scale, they will normally produce (or attempt to produce) the tone-semitone sequence of the major diatonic scale, ending one octave above their initial note. What is more, they will produce this scale sequence beginning with any random (but practical) pitch which may be sounded for them.

MATHEMATICAL BASIS

Mathematical investigation has shown that the natural frequency ratios used in the major diatonic scale are all based on whole-number fractions, as under:

Initial or keynote	1	1.000
Tone	9/8	1.125
Tone	5/4	1.250
Semitone	4/3	1.333'
Tone	3/2	1.500
Tone	5/3	1.666'
Tone	15/8	1.875
Octave	2	2.000

These precise intervals, used for the major diatonic scale, are said to be natural or "just" divisions of the octave —the latter a quite important word in musical terminology.

However, as most readers will appreciate in advance, "Western" music is not confined to the intervals comprising the Major Diatonic scale. Free use is made of the intervening semitones so that, in effect, each octave is really divided into twelve semitones and quite a large musical vocabulary is involved in describing certain sequences and relationships within the octave, all of them significant to music as an art.

But, again, a line must be drawn across the path of divergence.

Taking the keyboard of a piano as a familiar illustration, the span from middle C to the C above is one octave, the frequency relationship being exactly 2:1.

The two C's, together with all the notes in between, both black and white, divide the octave into what are nominally 12 semitones.

Why "nominally?"

We shall see presently!

Taking C as a starting or "key" note for the octave, the "Major Diatonic scale of C" can be played using only the white notes and omitting the black. Observation will show that playing the white notes produces the sequence: Tone, tone, semitone, tone, tone, tone, semitone.

As we inferred earlier, introducing certain "black" notes can produce other musically significant sequences in relation to the note C but we need to concentrate here only on the Major Diatonic sequence.

Moving up the keyboard one semitone from middle C brings us to C-sharp, or D-flat, which ever way we like to describe it. From this note to the corresponding one above represents an octave which can, in turn, be divided into twelve semitones.

But here we strike a major complication.

While the "natural" or "just" semitone intervals progressing from C-sharp upward fall very close to those based on the C-C octave, there is actually a very small frequency difference. Mathematically, this must be so. The observation is true in turn for other octave relationships and their natural semitone subdivisions.

This poses no special difficulty to a singer, a violinist or, in fact to any musician playing an instrument where the precise pitch of notes produced is under their immediate control. They can regard any individual semitone as the commencement of the octave and produce semitone intervals as they see fit. In other words, they can sing or play, using natural or "just" intervals, in any key signature.

In keyboard and certain other instruments, the frequency of individual notes is determined by prior tuning and cannot be manipulated during a performance by the player.

Therefore, taking the piano keyboard again as an illustration, it can be tuned quite readily to produce an exact sequence of semitones for the octave C-C. However, if the player seeks to change key and build his octave from another note, it would be found that the semitone intervals provided for the C-C octave, are not quite right for the new key signature.

Ways around this difficulty, which suggest themselves, include the following:

(1) Tune the instrument for only one key signature at a time, and play all music in that key. Musically, this is quite unacceptable.

(2) Provide the instrument with supplementary levers, knobs, etc., to allow the semitone intervals to be modified slightly during a performance to permit accurate key changes. This solution would be hopelessly complex mechanically (or electrically).

(3) Set the tuning so that key signatures most frequently used are to "just" intervals, or nearly so, but making other key signatures badly out. Known as "Mean" tuning, the method was widely used in early keyboard instruments. It is better than (1) but generally regarded nowadays as an unacceptable compromise.

(4) Provide a much more complex keyboard with a sufficient variety of "semitones" to allow the player to use the ones most appropriate to his selected key signature. This solution is unacceptable, both on account of the number of sound generators required and the complexity of the resulting keyboard. It has been calculated that something like fifty divisions would be required within each octave.

With all the above clearly ruled out, it is not surprising to find that there has been universal, if sometimes grudging, acceptance of the remaining course. This is seen, in practical form, in the present day piano or organ keyboard.

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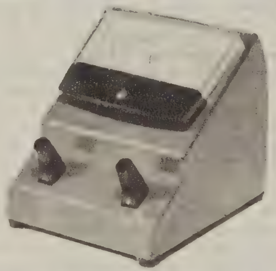

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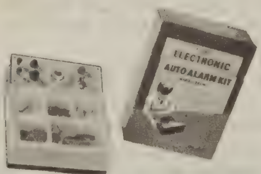

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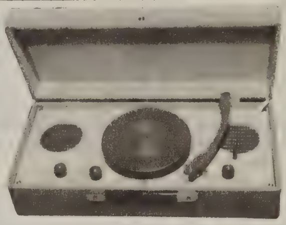

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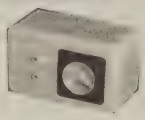

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emitones. As before, the word "nom-ial" is used deliberately, because the ntervals are set by tuning, not on the asis of the natural semitones of the just" scale, but to a set of frequency atios based on the 12th root of 2, he basic octave ratio.

On this basis, the frequency of each emitone in the octave is related to that f the adjacent semitone by this ratio vhich, correct to six decimal places, is .059463.

Repeated 12 times, the ratio must obiously produce the 1:2 octave relaionship.

Expressed to four decimal places, the atios within an octave are as follows: n brackets are the "just" ratios for the najor scale given earlier, indicating the rder of error.

C = 1.0000 (1.0000)
C sharp = 1.0595
D = 1.1225 (1.1250)
D sharp = 1.1892
E = 1.2599 (1.2500)
F = 1.3348 (1.3333)
F sharp = 1.4142
G = 1.4983 (1.5000)
G sharp = 1.5874
A = 1.6818 (1.6667)
A sharp = 1.7818
B = 1.8877 (1.8750)
C = 2.0000 (2.0000)

Tuning on the basis of these mathematically devised intervals distributes evenly the discrepancy between the semiones belonging to all the possible key signatures. No key signature is at a disadvantage with respect to any other and the assumption is that the error will not be of greater order than what even a musically trained person will accept as "normal."

Not surprisingly, this "tempered" scale came in for a good deal of criticism after its introduction and, even currently, there is a limited amount of activity in writing and recording "just" scale compositions. However, by and large, the tempered scale has won universal acceptance in "western" music.

It would seem likely, in practice, that some of the objections to the tempered scale stem, not so much from the planned inaccuracy, as from the danger of a Tuner adding error to error and producing plainly audible beats in chords, which may be further aggravated by superimposed vibrato. In short, by having to incude an initial error in his tuning adjustments, the Tuner has less latitude for additional errors of his own.

While the ratios listed above provide the basic means of subdividing any octave to produce a musically acceptable result, they are meaningless in terms of specific frequencies, unless related to some agreed standard. Here we uncover more argument.

Orchestral practice is to relate frequencies to the note "A" above middle C but much argument has followed as to what frequency should be assigned to it. The argument has had to do with the tendency for compositions to sound "brighter" or less bright with variations in pitch, the effect of concert hall temperature on instrument tuning, the ability of soloists to reach unduly elevated pitches and so on.

Thus, since about 1800, British orchestras have used a variety of pitch standards ranging from the original Philharmonic Pitch (1813) with A=424cps, to the Highest Philharmonic Pitch (1874) with A=455.5cps.

In an effort to resolve more than a century of confusion on the matter, an international conference was arranged in 1939 which set down a standard of A=440, and conforming to what had already been adopted in the U.S.A. There, choice of this precise figure had been influenced in turn by the relatively simple harmonic relationship between it and 60cps, which was the frequency of U.S. power mains and therefore basic to synchronous timing equipment.

AUDIO TOPICS

Because of the space devoted in this article to what is essentially an audio subject, our regular "Audio Topics" feature has been omitted from this issue.

This allowed gear trains to be set up, inter-relating the two for instrumentation purposes — a consideration which had not loomed very large in earlier years.

Since then, the A=440 standard has become firmly entrenched as the current "Concert" pitch to which new instruments are tuned. A very exact 440-cycle note is radiated by U.S. Standard Frequency stations and is also used by bodies such as the B.B.C. for interval and test tones.

Based on this standard, the frequencies of the notes within the octave above middle C can be written, correct to four places:

C = 261.6256
C sharp = 277.1826
D = 293.6648
D sharp = 311.1270
E = 329.6275
F = 349.2282
F sharp = 369.9944
G = 391.9954
G sharp = 415.3047
A = 440.0000
A sharp = 466.1638
B = 493.8833
C = 523.2511

The notes in other octaves are simple multiples or sub-multiples of these figures.

How closely these pitch standards are followed in individual cases, depends on circumstances.

In concert and professional circles, musicians, of necessity, are actively conscious of pitch, its possible variations and its implications.

In public halls and churches it is highly desirable to have organs and pianos on standard pitch to avoid problems if they are to be used, on special occasions with other instruments or instrument groups. Sometimes the instruments are "spot on"; sometimes just far enough off to cause discomfort!

In private homes and little, isolated halls and churches, the pitch of organs, harmoniums and pianos may easily be anywhere within a semitone either way Often they've been that way for as long as anyone can remember; most likely there has never been any need to do more than keep them in tune with themselves, without taking note of the random drift which occurs when this procedure is followed; perhaps the task of changing their pitch is too great, even assuming it to be practical!

BEAT EFFECTS

As already stated, the normal techniques of instrument tuning rely heavily on the phenomenon of musical "beats."

If two notes are sounded simultaneously, which are only a few cycles per second apart, in terms of frequency, one is likely to hear a "beat" between them, at a rate equal to the frequency difference.

For example, if a tuner excites a standard fork at 440cps, then sounds a pipe at, say, 437cps, he will hear a beat having a frequency of 3cps.

The reason why such beats are heard has been the subject of much argument, because normal "heterodyne" theory suggests that a non-linear function must be present somewhere in the chain before two frequencies can combine to produce sum and difference resultants. However, while non-linearities can be present in a variety of circumstances, there is good reason to believe that sufficient non-linearity is present in the aural sense to make beats audible, external conditions notwithstanding.

It would also appear that some people, by nature, are more conscious of beats than others. Again, people become more aware of beats if their attention is continually focussed on them by the nature of their occupation or studies.

Returning to the previous example, a tuner may, with some justification, consider his reference fork as an absolute standard at, say, 440cps. If he hears a 3cps beat with a musical note, he knows automatically that the note is that many cycles per second off pitch. He may or may not know, however, whether it is sharp (high) or flat (low).

The normal course is to make an adjustment on the device producing the note to flatten it very slightly, or the reverse. If flattening the note is found to increase the beat rate, then obviously the reverse adjustment is called for. If adjustment diminishes the beat rate, then it is in the right direction and can be pursued until no beat is apparent.

In practice, a beat of one cycle per second is very easy to hear and it only becomes difficult to pick after the rate

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PROCEDURE FOR SETTING TEMPERAMENT

PLAY	PLAY AND ADJUST	TUNE	ALTERNATIVE FIGURES
Fork 523.3 cps.	C above middle C	To exact pitch	To exact pitch
C above middle C	Middle C	To zero beat	To zero beat
Middle C	G	5 beats flat in 5 secs.	9 beats flat in 10 secs.
G	D	7 ,, ,, ,, 5 ,,	13 ,, ,, ,, 10 ,,
D	A	5 ,, ,, ,, 5 ,,	10 ,, ,, ,, 10 ,,
A	E	7 ,, ,, ,, 5 ,,	15 ,, ,, ,, 10 ,,
E	B	5 ,, ,, ,, 5 ,,	11 ,, ,, ,, 10 ,,
B	F sharp	7 ,, ,, ,, 5 ,,	17 ,, ,, ,, 10 ,,
F sharp	C sharp	5 ,, ,, ,, 5 ,,	12 ,, ,, ,, 10 ,,
C sharp	G sharp	5 ,, ,, ,, 5 ,,	10 ,, ,, ,, 10 ,,
G sharp	D sharp	7 ,, ,, ,, 5 ,,	14 ,, ,, ,, 10 ,,
D sharp	A sharp	5 ,, ,, ,, 5 ,,	10 ,, ,, ,, 10 ,,
A sharp	F	7 ,, ,, ,, 5 ,,	16 ,, ,, ,, 10 ,,
F	C above middle C	Check only 5 beats, 5 secs.	Check 12 beats, 10 secs.

Reprinted from our March, 1962, issue, the information in the first three columns was as given for tuning our own Stromberg/Playmaster organ. The figures in the fourth column, suggested by Richard Dorf, give marginally higher accuracy because beats are related to a longer period.

has diminished to one beat per several seconds.

Thus one beat in five seconds — a figure which can be checked if need be, with a watch second hand — would represent a frequency difference of exactly 0.2 cycle per second. Referred to 440cps, this would represent an accuracy of something under .05 per cent.

In short, an instrument tuner without elaborate aids, can work to the order of accuracy required for good tuning, using this long established technique.

The beat phenomenon is not confined to notes having fundamental frequencies of the same order. In fact, a quite clear beat can be heard when two notes are played simultaneously which are almost in octave relationship. The explanation would appear to be that the appropriate harmonic from the lower note interacts with the faundamental of the higher one to produce the audible beat.

Thus, if a "C" slightly mistuned to 260cps, is played with an accurate C-523.25, a beat would occur between the latter frequency and a harmonic on 520cps, to produce a 3.25-cycle beat. Similar phenomena can occur over double octaves and greater, though the beat may be less apparent.

In fact, tuners use the beat system to transfer pitch from one octave to the next. Provided the notes are adjusted for zero beat on each transfer, a high order of accuracy can be maintained. Thus, from a single A-440 fork, it would be a relatively simple matter to tune all the A's in a given instrument.

Nor does the process finish here. A beat can be heard between tones which are ostensibly quite unrelated in frequency but which happen to have harmonics which are substantially incidental.

Thus if middle C is sounded, its third harmonic, using the figures quoted earlier, falls on 261.6256 x 3 or 784.8768 cps.

If G above middle C is sounded, its second harmonic occurs on 391.9954 x 2 equals 783.9908cps.

Sound the two together and a beat is produced at a frequency equal to the difference between the two or 0.8860cps.

If one might interpose a thought at this point, these figures will elucidate earlier remarks in regard to the just scale, as distinct from the tempered scale. With just scale tuning, and assuming an octave beginning with middle C, the relationship between G and C would be a ratio of exactly 1.5 to 1. Obviously, with such a ratio, the third harmonic of the lower note would be exactly zero beat with the second harmonic of the higher one.

However, with the tempered scale, the ratio is 1.4983:1, and the tempered G is very slightly flat from the just G—sufficient, as we have seen, to create a beat between the two coincident harmonics of just under one cycle per second.

Considering another pair of notes, if the tempered G is sounded again, its third harmonic occurs at a frequency of 391.9954 x 3 equals 1175.9862cps. Sounding tempered D will produce a fourth harmonic at 293.6648 x 4 equals 1174.6592, the D being being slightly flat in relation to G, sufficient to produce, between the coincident harmonics, a beat of just over one cycle per second.

In actual fact, these figures give the clue to the beat method of instrument tuning, as set out in our March, 1962, issue, in connection with the "Stromberg-Playmaster" Electronic Organ. The table is reproduced herewith, in columns 1, 2 and 3.

The process involves setting C-above-middle-C to exact zero beat with a tuning fork. Middle C is then tuned to exact harmonic beat with this note and the fork to produce its required frequency of 261.6256 cps.

Then, playing middle C, the next step is to play the G above it, tune for exact harmonic zero beat, then flatten G slightly to produce a one cycle per second beat. This is best judged by adjusting so that 5 beats occur in 5 seconds, as read from the second hand of a watch.

The next step is to take G as the —standard and tune D slightly flat with respect to it, so that the harmonic beat is at the rate of 7 beats in 5 seconds.

So the process is followed, step by step, until all the notes have been set, the final step being to check the last one, F, to verify that it beats with C-523 to produce 7 beats in 5 seconds.

Having thus "laid out" the key octave in the manual, notes in other octaves can be brought to harmonic zero beat with their counterparts in the key octave

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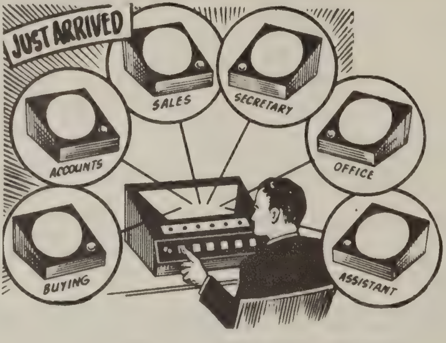

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TABLE OF HARMONIC FREQUENCIES BASED ON THE 12th ROOT OF 2

NOTE NO.	MATH. RATIOS	EQUIV. NOTE	FREQUENCY CPS (A = 440)	SECOND HARMONIC	THIRD HARMONIC	FOURTH HARMONIC
0	1.000 000 0	C	261.625 56	523.251 12	784.876 68	1046.502 24
1	1.059 463 1	C#	277.182 62	554.365 24	831.547 86	1108.730 48
2	1.122 462 1	D	293.664 77	587.329 54	880.994 31	1174.659 08
3	1.189 207 1	D#	311.126 98	622.253 96	933.380 94	1244.507 92
4	1.259 921 0	E	329.627 54	659.255 08	988.882 62	1318.510 16
5	1.334 839 9	F	349.228 24	698.456 48	1047.684 72	1396.912 96
6	1.414 213 6	F#	369.994 43	739.988 86	1109.983 29	1479.977 72
7	1.498 307 1	G	391.995 44	783.990 88	1175.986 32	1567.981 76
8	1.587 401 2	G#	415.304 73	830.609 46	1245.914 19	1661.218 92
9	1.681 792 9	A	440.000 00	880.000 00	1320.000 00	1760.000 00
10	1.781 797 5	A#	466.163 76	932.327 52	1398.491 28	1864.655 04
11	1.887 748 8	B	493.883 32	987.766 64	1481.649 96	1975.533 28
12	2.000 000 0	C′	523.251 12	1046.502 24	1569.753 36	2093.004 48

We are indebted to one of our readers, Mr R. L. Saunders, for the tables on this page, which he worked out, on the basis of the 12th root of 2, following delivery of the original lecture. Note the near coincidence of specific harmonics, which yield the beat frequencies listed below.

to bring them exactly on to tempered pitch.

Note that the table has been simplified to involve only whole numbers of beats—a quite practicable step—and that it applies to notes of nominal 8ft pitch within the octave above middle C. The fundamental frequencies involved therefore lie in the range 261 to 523cps. Tuning sequences, which involve other octaves or notes in adjacent octaves, also involve different beat rates, because of the different frequencies at which the harmonics may be coincident.

As a matter of interest, we have added to the table an extra column on the right hand, containing figures suggested by Richard H. Dorf, of the Schober Organ Company. Being taken over 10 seconds instead of 5, they allow a slight re-shuffle of the beat frequencies to produce somewhat higher accuracy.

Dorf's calculated accuracies for this column vary between .0002 and .004 per cent, the larger figure being well below the most optimistic requirements for accuracy of the tempered scale and negligible when compared with the accuracy likely to be achieved by practical tuners working with practical musical instruments.

In laying out a scale on a progressive basis, as described, the retention of overall accuracy depends to some extent on chance—whether the minor errors in adjusting individual tones are all in the one direction (and add) or in different directions, (and cancel).

But it would be less than fair to professional tuners to suggest other than the fact that a good tuner, working with a good instrument, can produce a result which is musically completely acceptable.

However, it would be equally unrealistic to deny that tuners have to overcome a variety of hazards to produce the desired result. Pipe organs are notoriously pressure and temperature conscious; electronic organs are less temperature sensitive, but have their own kind of frequency drift; reed organs are sensitive to wind pressure; pianos and similar instruments are sensitive to any alteration to the total distributed pressure which the strings exert upon the main frame; individual notes in some instruments tend to "pull" one another if sounded simultaneously—and so on.

Thus a tuning sequence can be thrown out by a slight frequency shift in a note which has just been set, the extent of the error only becoming obvious in subsequent cross-checking. The tuner may therefore be faced with tedious repetition, the end result being a "duel" between his time and patience, and the peculiarities of the instrument involved.

In the face of this situation, it is not difficult to understand why two or three professional tuners with whom we discussed the matter expressed interest in our talk of an electronic tuning aid; in the idea of a gadget which would produce any exact semitone, upon demand, and indicate visually when the note being tuned was on exactly the same frequency, or was an exact multiple or submultiple. Gone would be the reliance upon repetitive procedures.

BEAT FREQUENCIES

2nd + 3rd Harmonics:

C — G	0.885 80
C#— G#	0.938 40
D — A	0.994 31
D#— A#	1.053 42
E — B	1.115 98
F — C′	1.182 48

3rd + 4th Harmonics:

C — F	1.182 48
C#— F#	1.252 81
D — G	1.327 24
D#— G#	1.406 27
E — A	1.489 84
F — A#	1.578 32
F#— B	1.672 24
G — C′	1.771 60

The arithmetic difference between harmonic frequencies given in the table above yield this table of beat frequencies.

And, to the electronic serviceman, the value of such an instrument would be obvious.

However, it is one thing to be convinced that there is a place in the scheme of things for a tuning standard. It is quite another to conceive or produce one. And lest any reader should be inclined to dismiss the proposition lightly, let it be stated that numerous writers in technical journals have discussed and devised methods, all of them having merits and demerits but none, to the writer's knowledge, providing a completely satisfactory answer.

We, too, have burnt our share of midnight oil. We've contrived a workable unit, which is worthy of mention as an idea, but we have no special reason to believe that other experimenters in the field will be more impressed by our efforts than we have been with theirs! We present it primarily as a contribution to the literature.

However, before saying more about this particular unit, it may be helpful to set out some of the schemes which have been considered and the problems which are inherent in them, at least from the viewpoint of the would-be constructor.

TUNING FORKS: A tuning fork standard can be envisaged along the lines of the unit described in our October, 1961, issue but including a full octave of forks. The immediate problems of such a device have to do with the relative scarcity and high cost of suitable forks and the space required by a dozen forks, their mounting arrange-

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ment and their drive system. Further problems have to do with the possible shift in the frequency of a fork which is driven and their temperature dependance, which renders a heat-controlled oven desirable, if the project is to be pursued to its logical climax.

PITCH PIPES: Octave sets of pitch pipes are reportedly available more readily and cheaply than forks. However, we were deterred by the prospect of having to devise an easily reproducible blower system which could be incorporated in the same case as a microphone and the rest of the electronic circuitry. Since there seemed to be no simple solution to this problem, we did not pursue the proposition to the point of verifying actual availability, price, and accuracy of pitch pipes.

CONVENTIONAL BRASS REEDS: These are available readily enough from discarded reed instruments, new inexpensive instruments such as "Medolicas" or instrument repairers. Their pitch and reliability would vary with the source and tuning "in situ" would probably be required in most instances. The same problem with air supply is involved, as with pitch pipes, with the possible additional complication that reeds might be more sensitive to air pressure and temperature than pitch pipes. It is worth mention, in passing, that a "Melodica," in good condition and blown at moderate pressure, makes a handy guide for rough tuning. Electronic organ notes can be compared with it audibly or using a CRO, with a microphone feeding one set of CRO plates and the organ output on the other.

STEEL REEDS: These are much harder to come by than brass reeds but offer the interesting possibility of being excited magnetically rather than by air. Lack of suitable reeds and appropriately small driving coils have thus far prevented us from putting this idea to the test, but it is an interesting possibility.

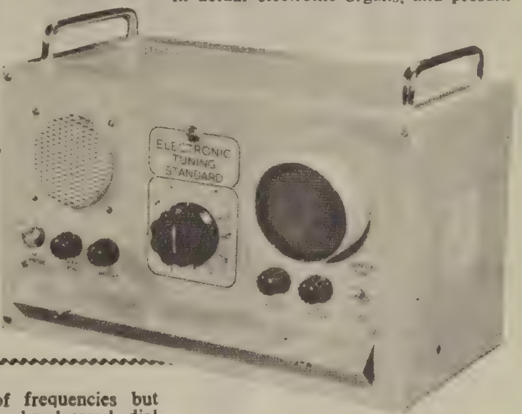
TONE WHEELS as in the Hammond organ. In the normal way, these rely for their accuracy on a synchronous motor, the short-term frequency stability of the power mains and gear trains sufficently complex to produce fractions of the original shaft speed lying very close to the decimal relationships within an octave of the tempered scale. From the average homebuilder's point of view, the mechanical problems are prohibitive, while the accuracy obtainable, considering the purpose, is suspect.

AUDIO GENERATORS of the BFO and Wien Bridge type. As already indicated, even high quality laboratory instruments lack the necessary calibration and re-set accuracy to be read to five significant figures. It is interesting to speculate whether, say, a Wien Bridge generator could be built to meet the requirements assuming: (1) Use of the highest quality components; (2) it covered only a single octave; (3) it was fitted with an elaborate bandspread dial or switched tuning, and (4) a tuning fork was inbuilt to check the ends of the scale and as many other harmonic beats in between as might be available.

FREQUENCY METERS: Much the same remarks apply as for active generators, above.

CRYSTAL LOCKED OSCILLATORS: Amateurs and others with the necessary experience could conceivably grind or etch disposals crystals to an octave relationship within the range, say, 2.61Mc. to 5.23Mc. However, even assuming the acquisition of suitable crystals, the problems of dividing down by 10,000 times, or thereabouts, to the actual musical frequencies poses considerable difficulty.

GENERATORS, HARMONICALLY RELATED: Typically, a unit of this type might involve a low frequency oscillator (at about 20cps), covering a small range of frequencies but provided with a wide bandspread dial scale. If its output is displayed on a CRO face against the individual notes of a reference octave, there will be frequencies within the range capable of producing stationary patterns with the various semitones. By noting these points and counting the pattern loops, the data can be used to lay out octaves in other instruments. As an alternative to a low frequency oscillator, a similar principle can be applied using a high-frequency oscillator. Difficulties of the scheme include: (1) the realisation of adequate oscillator stability and calibration and (2) the need, thereafter, for rather tedious reading of Lissajous patterns.



Built up originally to test certain ideas, this electronic tuning aid has turned out to be a very useful instrument. Details will be given next month.

BEAT FREQUENCY INDICATORS, of which the Schober Autotuner is typical. These employ a strobe wheel driven synchronously from the mains. Adjacent notes in the octave are pressed, one pair at a time and the direct arithmetic difference frequency is passed through a low-pass filter-clipper and made to flash a discharge lamp. Notes are adjusted, as specified to produce a stationary pattern on one or other of the strobe bands. While the device relieves the tedium of counting beats, it is still a progressive tune system, with its inherent limitations. Its accuracy is dependant on the short-term accuracy of the power mains, while the strobe pattern is also limited to whole numbers of lines. It would appear that the overall accuracy would fall short of critical musical requirements, while the method is of no use with instruments using shared oscillators.

FIXED-TUNED L/C OR R/C GENERATORS: These work on the basis of generating musical frequencies directly using the same kind of oscillators as are used for frequency control in actual electronic organs, and presumably with a comparable order of stability. In fact, a higher order of stability should be expected in a tuning standard, though its compact construction may accentuate temperature problems. Consideration must also be given to the problem of setting up the standard in the first instance. We shall have more to say about this in the next article. ◘

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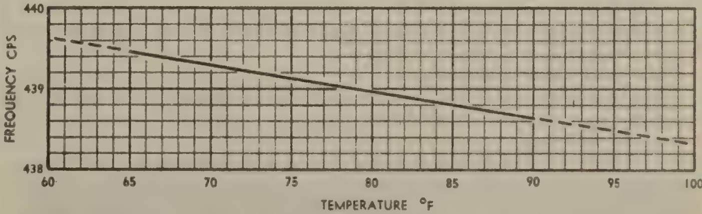

Standard musicians' tuning forks exhibit a marked change in frequency with temperature. The above curve for a typical fork is based on figures published by A. M. Seybold in "Audio," March, 1964. The error is of a similar order to that noted during our own experiments with instrument tuning methods.

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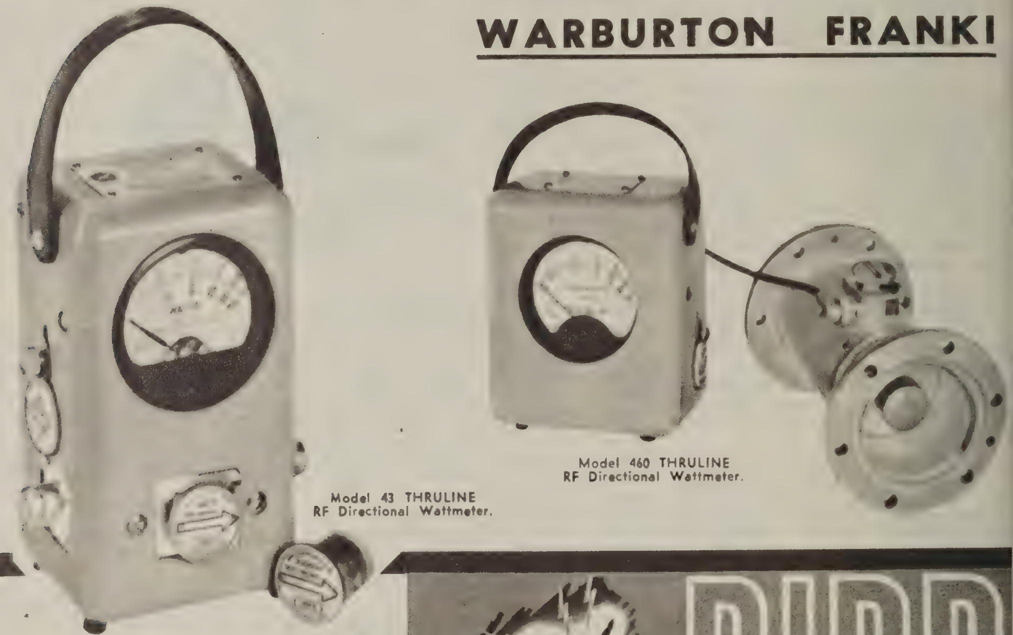

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Classical reviews

By JULIAN RUSSELL

BIZET, Carmen—The Complete Opera

Bizet—Carmen. Complete Opera. Leontyne Price (Carmen); Franco Corelli (Don Jose); Robert Merrill (Escamillo); Mirella Freni (Micaela); Monique Linval (Frasquita); Genevieve Macaux (Mercedes); Frank Schooten (Zuniga). Vienna Philharmonic Orchestra, Vienna State Opera Chorus and Vienna Boys' Choir conducted by Herbert von Karajan, R.C.A. Stereo (three discs) LDS6164.

When discerning listeners think of Carmen, most will set as a standard the Beecham version issued about five years ago. This will principally be due to the incomparable swagger with which Beecham directed the whole production. It was alive with vital tempos and exquisite French finesse.

Now, the present issue under consideration, though it has much in its favour, especially in the casting of the three main roles, just falls short of Beecham's brilliance in the general direction. For it must be faced that, by comparison, many of Karajan's tempos are slow, and sometimes downright laggard, and he often replaces sparkle by solidity.

This can, and often does, have a dulling effect on Bizet's effervescent score, though under Karajan the playing of the Vienna Philharmonic is beautifully precise and well organised and there is very much indeed to be admired and enjoyed in their performance. You may even be one of those who approve Karajan's tempos, in which case you need look no further for a splendid production of the opera. If, however, you are not and are seeking a new recording of Carmen I suggest you wait until the new Callas version is available before you decide.

Leontyne Price is a wonderful tempestuous Carmen, full in voice with the right dark tones emerging in such scenes as the Card Trio and elsewhere, superbly assured in her characterisation but marring it now and again with cheeky little outbursts that tend to reduce the stature of the character. Hers, however, is a grand Carmen.

Franco Corelli sings Don Jose as if he loves every note of the role. I have rarely heard so enthusiastic a performance, quite carrying one away so that minor inexactitudes can be comfortably ignored. Robert Merrill has nowadays made Escamillo very much his own role and here he is in fine form vocally and dramatically.

I am afraid I cannot be so enthusiastic about the minor characters who give sound but not inspiring performances of their roles. But both choirs are fine and the handling of the many ensembles by Karajan always characterised by his exemplary discipline. The sound is great.

Dvorak—"New World" Symphony

Dvorak—"New World" Symphony in E Minor, Op. 95. Philharmonia Orchestra conducted by Otto Klemperer. Columbia Stereo SAXO2554.

Tchaikowsky, Berlioz, and now Dvorak! Klemperer is certainly becoming far more eclectic in his choice of composers than in the old days when he confined himself to the works of Beethoven, Brahms, Wagner and occasionally Mahler. His moulding of the "New World" is sculpturally admirable, solidly graceful in torso but a little on the heavy side in the limbs. Some of his tempos sound a little slower than they really are, as a check with a metronome will quickly reveal. It is the weight of his interpretation that produces this effect.

Now and again a tempo—the Scherzo as an example—is actually slower than usual yet it never seems to drag since it is always perfectly scaled to proportion with the rest of the work. Perhaps the most astonishing movement in a highly individual performance is the famous Largo in which Klemperer abandons the old idea of landscaping a majestic forest and substitutes instead a threnody of moving sadness. You will find this movement an unforgettable experience.

The sound is magnificent and Klemperer takes full advantage of the wide dynamic range, producing some exciting climaxes but saving the finest of all till the end. You will certainly find this reading different, and whether it appeals to you or not, it should certainly command your respect.

* * *

Bach—Two and Three Part Inventions. Glenn Gould (piano). C.B.S. Stereo SBR235087.

This disc should be invaluable to students who wish to study these wonderfully ingenious little pieces and ordinary listeners who wish simply to surrender to their charm. Unlike some of his previous performances, Gould indulges in no extravagances here. His playing is straight forward, much of the ornamentation conforming to modern Bach scholarship — though some of it doesn't —and an occasional tempo, while unusual perhaps, is never freakishly so.

Listeners with keen ears will be interested in the instrument Gould uses, a prewar Steinway redesigned by Gould to better suit baroque music. To do this Gould altered the distances between the hammers and the strings and readjusted the after-touch mechanism. The resulting tone is drier than that of a modern instrument, less reverberant, and much restricted in dynamic range, though the last characteristic may be the result of the way in which the player uses it. He is, for instance, very sparing in the use of the pedal.

The new set-up does nothing to spoil the effect of legatos or rhythm, which under Gould's fingers, is always buoyant. I am also happy to be able to report that, in this example at any rate, he has abandoned those vocal interjections that sometimes irritatingly marred some of his previous recordings.

* * *

Prokofieff—Symphony No. 5 in B Flat, Op. 100. Orchestra of the Swiss Romande conducted by Ernest Ansermet. Decca Stereo SXL6120.

If this is a sober reading it is none the less exciting for that reason. Ansermet resolutely avoids making it a vehicle for orchestral virtuosity, perhaps wisely in view of the fact that, good as it is, the Swiss Romande is not by any means a virtuoso combination. If you get the impression from my use of the word sober that this is a dull performance you need only to listen to Ansermet's sprightly tempos in the first movement to disabuse yourselves.

His treatment results in a tightening of the tension and added vitality to a movement that can, in other hands, seem to drag interminably. And throughout the whole work Ansermet displays yet again his beautiful sense of proportion not only in parts but in the whole. Thus he rightly transfers the climax of the work to the third movement but without drifting into anticlimax in what follows. There are some momentary blemishes here and there on the clarity of the orchestral diction but all in all this is for me easily the best performance of the work available at present. The sound is first rate.

* * *

Mozart—Violin Concertos. No. 7 in E Flat (K.268); Concertone in C Major (K.190). Yehudi Menuhin and Alberto Lysy with the Bath Festival Orchestra. H.M.V. Stereo OASD592.

The term "concertone" is not defined in Scholes' compendious "Oxford Companion to Music" but from what I can gather from other sources Mozart used the word to describe an offspring of the baroque concerto grosso influenced to some extent by the sinfonia concertante. Thus the violin parts played by Menuhin and Lysy do not stand out as they would in a true concerto but modestly blend into the whole.

There are other important solo parts—the oboe's, cello's and two violas'—but the nature of the recording technique gives the two violins just a shade of prominence. Without this the term sinfonia concertante would have suited the work admirably. I will surprise no one when I say that the playing of all concerned is a continuing delight—limpid in texture and spontaneous in thought. The work should be of vast interest to all scholars.

The Seventh Concerto on the reverse side is of decidedly less interest. It is of very doubtful origin, indeed, if any of it was written by Mozart at all, it was a Mozart in a very off mood. So much so that the Mozart scholar Oldman has described the slow movement as "a crude forgery." As if to impress its authenticity on listeners, Menuhin plays it for all its

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worth—whatever that adds up to. He tends to over-emphasise in what is, for him ,a most unusual manner. But I still doubt his ability to convince any listener of discernment that this is good Mozart, or indeed, Mozart at all.

★ ★ ★

Feodor Chaliapin (Great Recordings of the Century Series) in a recital of Arias and Songs by Rachmaninoff, Rossini, Gounod, Ibert, Moussorgsky, and a selection of folk songs. H.M.V. COLH141.

These recordings were made between 1926 and 1933 and Chaliapin was no longer young when he made the first, the "Calumny" aria from Rossini's "Barber of Seville." In this, by the way, he was accompanied by an orchestra conducted by the then Mr Eugene Goossens. Chaliapin was not at his best in this Italian aria, nor in the two excerpts from Gounoud's "Faust," "The Calf of Gold" and Mephistopheles' "Serenade."

He is here, however, surprisingly good in the Ibert bracket of songs written for him to sing in the film "Don Quichotte," which he recorded when he was just 60. They are delicious French trifles, elegant, witty, with a nervous vocal line moving freely over Poulencian bitter-sweet harmonies. I should like to hear them re-recorded with more modern techniques and a good French singer to deliver them. But as you find them here they are still eminently enjoyable.

But it is in the Russian songs that you will find Chaliapin at his very great best, his interpretive powers unimpaired and his voice still noble and handsomely managed. Moussorgsky is represented by the "Trepak" from the "Songs and Dances of Death," the "Song of the Flea," some of the Russian epigones contribute more songs and arias, and such popular folk favourites as the "Song of the Volga Boatmen" and "Down the Petersky" complete the recital. There is, too, an impressive account of Gretchaninoff's twofold litany, "Glory to Thee, O Lord."

The transfer to LP has been made with almost complete absence of 78 surface noise and Chaliapin's voice emerges undistorted. The orchestral accompaniments are, of course, very wraithlike in terms of more recent techniques, but then no one expects them to be any more lifelike in this type of re-creation.

★ ★ ★

Beniamino Gigli (Great Recordings of the Century Series) in a recital "The Young Gigli." Arias from "La Gioconda," "Tosca," "Mefistofele," "Cavalleria Rusticana," "La Boheme" and others. H.M.V. Mono COLH146.

All the pieces on this disc were recorded in 1918-19 when Gigli was just starting to attract attention. His voice has not all the mature fullness it acquired in later years but it was already rich in its characteristic qualities of flexibility, and sweetness. His phrasing, though good, had not yet developed the eloquence that was to come later, but it must have been very impressive indeed in such a young singer.

All the 78s re-recorded here have been so rare as to be nowadays very high-priced collector's pieces. His program consists of arias from Ponchielli's "La Gioconda," Puccini's "Tosca" and "La Boheme," Boito's "Mefistofele," Mascagni's "Cavalleria Rusticana," Donizetti's "La Favorita" and Giordano's "Fedora."

I found one of the most attractive features of the disc the absence of the pain-laden lachrimosity that Gigli developed in later years, that made almost everything he sang sound like "Vesti La Giubba" from "Pagliacci" or "E Lucevan le Stelle" from Tosca.

★ ★ ★

Haydn—Concerto No. 3 in G for Two Guitars and Chamber Orchestra. Duo Pomponio-Zarate and Lamoureux Chamber Orchestra under Mari, Schubert/Matiegka—Quartet in G for Flute, Guitar, Viola and Cello. Werner Tripp (flute); Konrad Ragossnig (guitar); Karl Stierhof (viola); Adalbert Skocic (cello). RCA Stereo LSC2772.

The Haydn concerto was originally composed for a musical oddity called a lira organizzata, long since defunct. It was a type of hurdy-gurdy, handcranked to spin a wheel which rubbed against the strings while the player used his left hand to stop the notes by means of keys. It could produce only single notes and had a set of sympathetic strings to reinforce the tone. Its tone was rather like a violin played without present-day vibrato.

Haydn later rearranged it in the form given here in which one can enjoy much elegant playing by guitarists Jorge Artinez Zarate and his wife Garciela Pomponio. The Lamoureux Chamber Orchestra under Jean-Baptiste Mari supplies exemplary support. The work is typical of Haydn—an unfailing flow of invention treated with inexhaustible ingenuity. I found it entirely delightful.

The other work was expanded by Schubert from a piece composed by Matiegka, its chief interest lying in the piquant timbres produced by the unusual combination of instruments. It is all pleasantly relaxing if lightweight entertainment. Throughout both works the ensemble is excellent and the engineering of impressive fidelity.

★ ★ ★

Falla—The Three Cornered Hat. Complete ballet. Philharmonia Orchestra and Victoria de los Angeles, conducted by Rafael Fruhbeck de Burgos. H.M.V. Stereo. OASD608.

This is as fine a performance and recording of the complete ballet as you're likely to hear in many a long day. Fruhbeck plays it with minute attention to detail—phrasing, dynamics, accent and rhythm. It sounds as if he had every note in the orchestra on the end of his baton. Yet the effect is in no way precious, indeed the vitality of its propulsion is one of its most impressive features.

You may find some of the tempos slower than in the Ansermet version. It may be recalled that Ansermet was the first to conduct the ballet when its was produced by Diaghileff back in the early 1920s. It is perhaps for this reason that his tempos are more those of the theatre than the concert hall. At any rate Fruhbeck's slightly slower pace here and there in no way robs the native Spanish rhythms of their exhilarating buoyancy and he manages to find time to give the slower reaches of the score time and space to breathe.

I was a little disappointed with Victoria de los Angeles' contribution. She is altogether too ladylike in these rough gipsy songs. Her voice has quite marvellous purity, but that is not what is needed here. Rather one looks for the slightly coarser exuberance of a Supervia. However this was the only blemish I could find on an otherwise perfect and exciting disc.

★ ★ ★

Humoresque — Short piano pieces by Dvorak, Rachmaninoff, Debussy, Beethoven, Tchaikowsky and others, played by Leonard Pennario. RCA Stereo LCS239.

Here is acceptable entertainment if taken a little at a time. Each of the small compositions has some merit despite its dimensions. Among the best might be mentioned Debussy's "Golliwog's Cakewalk," Schubert's "Moment Musical No. 3" and Falla's "Andaluza." You will find here, too, Beethoven's "Fur Elise," Tchaikowsky's well-known "Sleigh Ride" and Grieg's "To Spring."

Less familiar might be "Three Preludes," by Gershwin, pieces which foreshadow later works such as the "Piano Concerto" and "An American in Paris." Tchaikowsky contributes a second, less well-known piece, the "Scherzo Humoristique," of considerable difficulty. And there are, of course, three "Humoresques" from which the disc takes its name, by Dvorak, Tchaikowsky and Rachmaninoff.

Pennario plays them all admirably, unmarring them by sentimentality, adorning them with crisp articulation, and dropping, on this occasion at least, the tendency to slickness he so often shows. This is the sort of disc to use with discretion—a little at a time.

★ ★ ★

Brahms—Concerto, No. 1 in D Minor. Van Cliburn and the Boston Symphony Orchestra conducted by Erich Leinsdorf. RCA Stereo LSC2724.

Playing this performance through a second time I couldn't rid myself of the feeling that the first movement is still a little on the big size for this young pianist. The wide range of emotional expression it demands seem just out of the soloist's grasp. Cliburn is never less than competent technically but is expressively a little wan though there are some quite delicious small episodes.

He is more comfortable in the quiet musings of the second movement, though even here there are long passages when Cliburn appears to be outside the framework of the music and lacking personal involvement. He is at his best in the

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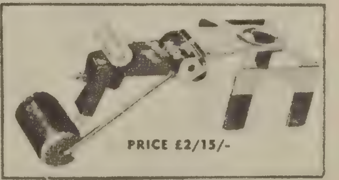

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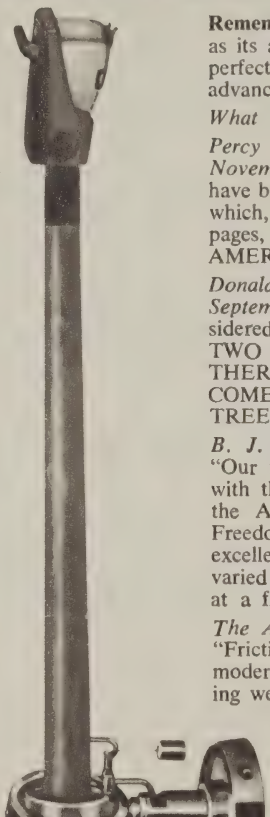

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buoyantly rhythmic Finale which, in addition to vigour, has its immensely pleasing moments of delicate sketching.

Leinsdorf is content to follow Cliburn's pattern of emotional restriction. What else could he have done to preserve the congruity of the performance? But he is one of those conductors who do nothing to lighten the thickness of Brahms' scoring by extra careful attention to internal balance, particularly in the middle voices. Such refinements of balance seem to him quite unnecessary.

★ ★ ★

The Play of Herod. A Medieval Musical Drama scored for Voices and Instruments by Noah Greenberg. Sung and played by the New York Pro Musica with the Boys' Choir of the Church of the Transfiguration, New York, conducted by Noah Greenberg. Festival Stereo SFC 931442/3.

Those who own, or have heard "The Play of Daniel" in the Noah Greenberg recording will by now know what to expect from this, his latest contribution to medieval musical scholarship. The two works resemble each other closely in their lay-out of choruses and instrumental interludes, the latter usually in the form of processionals. Much of the music has the same strongly modal flavour that distinguished that of "Daniel." The reconstructed ancient instruments provide many piquant "new" timbres to fascinate 20th century ears.

Greenberg's scoring for voices and the beautifully disciplined choir under his direction supply endless changes of colour. The work was performed late last year in the crypt of St. Mary's Cathedral, Sydney, in much the same form as it is heard here, except that, on the occasion of its live performance, a spoken commentary narrated the action. Here no commentary is used.

RECOMMENDED

Debussy—Images pour Orchestra (Gigues; Iberia; Rondes de Printemps). Jeux. Orchestra of the Paris Conservatoire conducted by Andre Cluytens. Columbia Stereo SAX02548.

Respighi—Pines of Rome; Fountains of Rome. Orchestra of the Swiss Romande conducted by Ernest Ansermet. Decca Stereo SXL6141.

Brahms—Complete Piano Works, Vol. 3. Sonata in C Major, Op. 1; Sonata in F Sharp Minor, Op. 2. Julius Katchen. Decca Stereo SXLA6129.

Alec Guiness—A Personal Choice. Readings from Shakespeare; e. e. cummings; Edith Sitwell; W. H. Auden; Ogden Nash; Robert Browning and others: RCA Mono VDM102.

Jussi Bjorling (Treasury of Immortal Performance Series) in Operatic Duets with Robert Merrill and operatic Scenes with Licia Albanese, Zinka Milanov, Roberta Peters and Leonard Warren. RCA Mono LM2736.

Mozart — Trio in E Flat Major for Clarinet, Viola and Piano (K.498) Quintet in A Major for Clarinet and Strings. Gervaise de Peyer (clarinet) with Members of the Melos Ensemble. HMV Stereo OASD605.

Mozart—Sonata for Two Pianos in D Major. (K.488). Schumann — Andante and Variations for Two Pianos, Two Cellos and Horn. Vladimir Ashkenazy and Malcolm Frager (pianos); Amaryllis Fleming and Terence Weil (cellos); Barry Tuckwell (horn). Decca stereo SXL6130. ■

DOCUMENTARY RECORDS

Reviewed by Ellis Blain

A PERSONAL CHOICE. ALEC GUINNESS. R.C.A. VDM102

A series which represents an approach which is akin to that of an A.B.C. television series which was shown late last year when celebrities were asked their views on all manner of subjects, the majority of which had no connection with their professional field. As a result, you came away feeling you knew a good deal more about each V.I.P. as a person rather than as a professional.

After listening to this record and digesting the brief but illuminating notes by Sir Alec Guinness, I will be surprised if your conception of him as an individual has not advanced considerably. His choice is wide and colourful, ranging from Shakespeare to Ogden Nash. It also includes Robert Graves, Hilaire Belloc, Wilfrid Owen and the 'modern" American poet, E. E. Cummings.

He reads all the verse himself, for he most part very well if rather unconventionally and with each reading he reveals some aspect of himself rather han of the poet. Truly, a personal choice ınd, for me at any rate, a stimulating ınd sometimes fascinating one.

★ ★ ★

'I LIVED IN CHURCHILL'S TIME." A Tribute To Sir Winston Churchill by Sir Robert Menzies, HMV 7EGO 70047.

This E.P. is certainly the most concise of the many Churchill memorial ecords which are available. If my nemory serves, it is taken direct from one of the B.B.C. broadcasts at the ime of the funeral. The Prime Minis- er is a fine speakers and his tribute is moving one. On the other hand, you nay prefer a more comprehensive iography such as the splendid R.C.A. —N.B.C. production reviewed last nonth or even the twelve-record lbum released by Decca.

★ ★ ★

NTHOLOGY OF SPOKEN POETRY No. 1, T. S. Eliot. ARGO RG10.

This is not to be confused with the urrent series on Argo. "The English 'oets From Chaucer To Yeats." It was, n fact, one of the very first Argo records eleased and I should think the series vas completed or discontinued long go. It has been made available again y the Australian Agents as a result f the death of T. S. Eliot early this ear and, as it contains several of his est known works, is most welcome. 'he Reader is Robert Speaight, who oured Australia in a lecture recital nostly devoted to Eliot, about ten years go. These lectures created a lot of interest at the time and I have no doubt hey will be remembered with affection, s Speaight is a splendid speaker and is association with Eliot was a long nd intimate one. The poems represented in this collection are "The Vaste Land," "Ash Wednesday," "The Hollow Men" and "The Love Song of Alfred Prufrock." Of these, Prufrock is the easiest to appreciate as s emotional message is comparatively direct. It is a poem which is included in most anthologies and has led many people to enjoy later and sometimes more complex poems.

It would be interesting if a popularity poll could be taken on contemporary poets. I have a strong feeling that T. S. Eliot would have rated high in such a poll a generation ago, almost alongside the much slighter and more immediately appealing Rupert Brooke. But today I am not so sure and, of course, it is too early for any lasting evaluation to be made of the worth of his contribution to English literature.

As a recommendation, I can only suggest that this record is worth the price for Prufrock alone and you may well find that after a few hearings, the irony and preoccupation of the others, with despair, frustration and redemption may seem less forbidding — despite the classical quotations and sometimes abstruse cross-references which are only partially offset by the racy colloquialism of much of the language.

★ ★ ★

ANTHOLOGY OF SPOKEN POETRY. Four Quartets by T. S. Eliot, spoken by Robert Speaight. Argo RG11.

Following on the previous review, this is perhaps Eliot's greatest work in pure poetic form. Written over a period from 1935 to 1942, is profound, symbolic and contemporary. Contemporary but never merely topical. If you have reached an appreciation of the later poems on RG10 then you will need no persuasion from me to graduate to RG11.

> **"No talker, however good, can create a good conversation if he doesn't listen to what the other person says."—Lord David Cecil.**

PRACTICAL CATS, read by T. S. Eliot. ARGO RG116.

There is nothing frightening about these . . . They are some of the most delightful cat poetry ever written and Eliot's lazy charm as he reads each piece adds to its appeal despite the fact that, like most poets, he is quite unprofessional as a reader. It would be impossible to recommend these too highly as they are gems of spoken word on record and unique in that they are spoken by the author. Some of the titles should give a clue to the content . . . "The Naming Of Cats," "Gus: The Theatre Cat." "Old Deuteronomy" and my personal favourite, "Growltiger's Last Stand." The recording, which was made under the auspices of the British Council, is excellent. ◘

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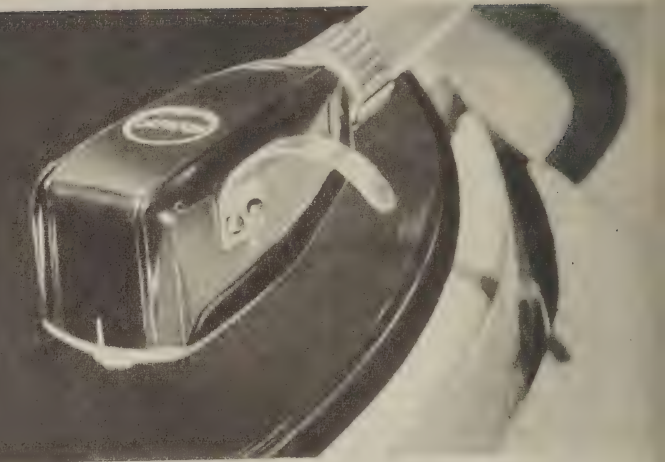

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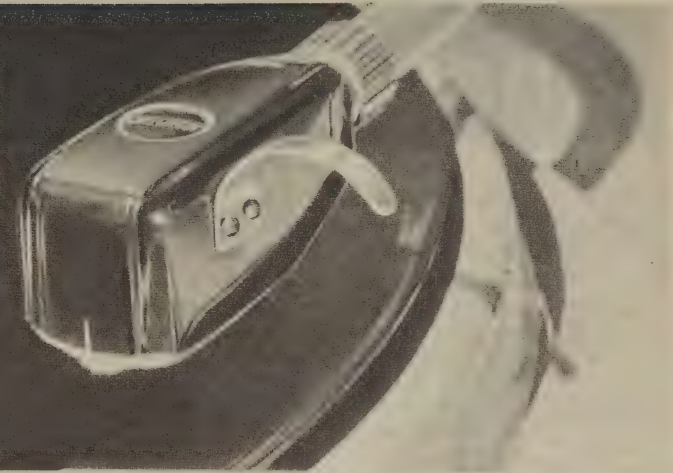

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MESSIAH, Handel. The London Philharmonic Choir, The London Philharmonic Orchestra. Conducted by Walter Susskind. Choirmaster, Frederick Jackson. April Canteno, Soprano; Helen Watts, Contralto; Wilfred Brown, Tenor; Roger Stalman, Bass; George Malcom, Harpsichord; Harold Drake, Organ. Stereo, Astor GGS-611.

Interest: Famous Oratorio.
Performance: Rich and full.
Quality: Excellent.
Stereo: Good spread and definition.

This most famous oratorio, Handel's Messiah, is most frequently associated with the Christmas and Easter seasons nd this review should, logically have ppeared in the April issue. But this is mere observation, for the music of Messiah is not limited to times and seaons.

Especially can I recommend this roup of complete and well-known arias o those who are more used to Gospel music than to full length symphony concerts; they will find this record as nspiring as it is listenable.

The arias, in order are:

"And The Glory Of The Lord," "Beold A Virgin Shall Conceive," "O Thou That Tellest Good Tidings," "To Zion," "For Unto Us A Child Is Born," There Were Shepherds Abiding," "Beold The Lamb Of God," "Lift Up Your Heads," "Why Do The Nations So Furiously Rage," "Hallelujah," "Since y Man Came Death," "Worthy Is The amb That Was Slain," "Amen."

Recorded in St. Mary Magdalene Church, Paddington, London, the sound full, well balanced and clean and will ot disappoint those with hi-fi ears. Recommended (W.N.W.).

* * *

MY FAVOURITE HYMNS. Jimmie Rogers, Arranged by Milt Rogers. Mono, Dot (Festival) ZL-31,511.

Interest: Popular hymns.
Performance: Smooth.
Quality: Excellent.

Seeing the name "Jimmie Rogers" on jacket, anyone not quite up with the pop" field might be pardoned for asming that it referred to Jimmie Rogs, "the singing brakeman" and widely cknowledged as the father of country nd western music, as we know it toy.

Not only that, but the portrait alongde the name bears a striking resemblnce to the same legendary figure, who ed in May, 1933, at the age of 36, a ctim of tuberculosis.

However, it is obvious from the first rs that the sound on this disc is not at of the early thirties, while the different label and inclusion of the relatively modern "It Is No Secret" further indicate that the original Jimmie Rogers is not the man involved.

The jacket gives no clue but a phone call to Festival cleared up the problem. The Jimmie Rogers recorded here is a rising star in the pop field, any resemblance to the earlier figure being (allegedly) purely coincidental.

Having said that, I can record that the new Jimmie Rogers has a pleasant baritone-cum-tenor voice. He presents here a group of well known hymns, with chorus and instrumental backing, in a style fairly popular, though by no means extreme.

"Beyond The Sunset," "Just A Closer Walk," "It Is No Secret," "Peace In The Valley," "Let Us Break Bread Together," "Whispering Hope," "The Old Rugged Cross," "Nearer My God To Thee," "Yield Not To Temptation," "What A Friend We Have In Jesus" and "Precious Memories."

A middle-of-the-road disc which should be quite popular. (W.N.W.)

* * *

MAN IN THE 5th DIMENSION. Presented by Billy Graham from his World's Fair Pavilion. Mono, RCA Camden CAL-813.

Interest: Billy Graham film sermon.
Performance: Sound track style.
Quality: Excellent.

This recording is dubbed straight from the sound track of the Billy Graham film currently being shown in his World's Fair Pavilion . . . "Man In The 5th Dimension." Judged only on this recording, the film is, obviously enough, an illustrated sermon, along similar lines to the popular sermons from science, distributed by the Moody Bible Institute.

Billy Graham dwells for a while on the wonders of the universe, then passes to the thought that this design speaks eloquently of a designer, who is God. He explains the redemptive work of Christ and then asks, in effect, whether Epistles has any relevance in this modern age. He answers it by quoting from respected figures of science and history and then presents the personal challenge.

As noted above, the sermon has the characteristics of a sound track—a little hurried, somewhat mechanical and interspersed by brief snatches of Ralph Carmichael's theme music but I think many would consider the disc well worth the investment, particularly at Camden's economy price.—(W.N.W.).

* * *

JESUS LOVES ME . . . Hymns For Children. John, Mary and the Village Choir. Mono, 45EP, Festival FX-11,000.

HE'S GOT THE WHOLE WORLD IN HIS HANDS . . . Hymns for Children. John, Mary and the Village Choir. Mono, 45EP, Festival FX11,001.

Interest: Debatable.
Performance: Ordinary.
Quality: Fair only.

These two EP discs prompt me to speculate, once again, on an appropriate definition for children's records. Are they (1) records specially designed and carefully recorded for a child audience or (2) records which aren't good enough for adults? Having said this, I list my jottings covering the six tracks.

On FX-11,000:

"Jesus Loves Me"—Very ordinary singing, high distortion level.

"A Mighty Fortress Is Our Lord"—Trumpets, minor key and all that; is this children's material?

"God So Loved The World"—Strictly "village choir" standard, plus tape hiss.

"I Am A Poor Wayfaring Stranger" —Ridiculous bass from organ, intermodulating the voice.

On FX-11,001:

"He's Got The Whole World In His Hands"—Best track so far; not bad, in fact.

"Goodnight Sweet Jesus"—That exaggerated bass again but not too bad this time.

"O God Our Help In Ages Past"—Heavily arranged, plus trumpets in minor key; choir just so so. Please, is this children's material?

And there you have it. But if you do want to try one of these it had better be FX-11,001.—(W.N.W.).

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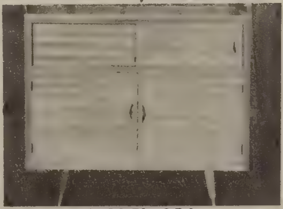

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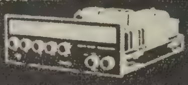

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AMPLIFIER & CONTROL UNIT SECTIONS
(Models 222, 226, 227, 227M)

Power Output	10 watts push-pull.
Frequency Response	30-20.000 c.p.s. plus/minus 1dB.
Power Response	35-20.000 c.p.s—1dB.
Harmonic Distortion	Less than 0.5% at 1K/cs measured at 8 watts output plus minus 1dB.
Hum and Noise	55dB below rated output.
Negative Feedback	15dB.
Output Impedance	Alternative 4, 8, 16 ohms.
Transient Response	Rise time 6 micro-secs.
Treble Control	+15dB.—12dB. at 10K/cs.
Bass Control	+12dB.—12dB. at 70 c.p.s.
Rumble Filter	−6dB at 35 c.p.s increasing at lower frequencies.
Input Sensitivity (Radio, Pickup, Tape)	80mV at 2 M ohms.
also on 226 only	3.5mV at 50K.
Tape Recording	500mV output. Low impedance.

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(Models 223, 226, 227, 227M)

Coverage	Medium waveband 180—600 metres, 500—1650 K/cs.
Sensitivity	5 uV for 20dB quieting at 30% modulation.
Intermediate Frequency	430 K/cs.
I.F. Rejection	60dB.
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Filter	Heterodyne rejection filter.

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Crosstalk	Better than 40dB.
Channel Matching	plus/minus 1dB.
Balance Control	Range of −10dB each channel

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Power Output	Ultralinear, 12 watts per channel.
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Frequency Response	15—22-000 c.p.s. plus/minus 1dB.
Power Response	20—18,000 c.p.s.—1dB.
Harmonic Distortion	Less than 0.1% 1K/cs measured at 12 watts output plus/minus 1dB.
Hum and Noise	80dB below rated output.
Negative Feedback	29dB.
Output Impedance.	Alternative 4, 8, 16 ohms.
Transient Response	Rise time 4 micro-secs.
Crosstalk	1K/cs—52dB. 10K/cs—40dB.
Channel Matching	plus minus 1dB.
Mains Input	A.C. 100—130 & 200—250 volts.

225 STEREO PRE-AMPLIFIER

Frequency Response	20—20.000 c.p.s. plus/minus 1dB.
Harmonic Distortion	Less than 0.1% at 1K/cs.
Crosstalk	1K/cs—48dB. 10K/cs—30dB.
Channel Matching	+1dB.
Balance Control	Range of −10dB each channel.
Treble Control	+12dB−10dB at 10K cs.
Bass Control	+15dB−10dB at 70 c.p.s.
Rumble Filter	Turnover 80 c.p.s 6dB per octave.
Treble Filter	Variable frequency and slope.
Tape Recording	400mV output. Low impedance.

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THE YEARS OF CHALLENGE. Wartime speeches By Sir Winston Churchill, K.G., O.M., C.H., D.L., M.P. Mono, 2-Record Set, World Record Club ME/2121, ME/2122
Interest: Historic speeches.
Quality: Good.

To anyone who remembers the grim days of World War II, these speeches by Britain's wartime Prime Minister will need no introduction. However, as I sat down to listen to them again, at this remote point in time, my first reaction was something of a let-down. Where was the fire and the emotion that I seemed to remember?

But as I continued to listen, I began to recapture some of the atmosphere against which these speeches had been delivered and to recall that their impact had not been in flights of oratory but in a calm reason and assurance, which saw victory beyond the perils of the moment.

In fact, I ended up listening to the four sides at one sitting — and found myself wanting more. The selection begins with Churchill's first speech as Prime Minister, just as Nazi columns burst into France ("In A Solemn Hour"). Then follows, on record 1, "This Was Their Finest Hour" immediately after Dunkirk and "War Of The Unknown Warriors," a call to the British people to stand firm.

Record 2 begins with "Every Man To His Post," warning of an invasion that had to come, if Hitler was to subdue England. "Frenchmen, Re-Arm Your Spirits" was a message of hope to a nation under the Nazi jackboot; "Westward, Look, The Land Is Bright" (April, 1941), preceded the entry of Japan and America into the war but glowed with firm hope of final victory.

There is no spoken commentary and no injected continuity on the discs, apart from the jacket notes. They are simply recordings of momentous speeches and, as such, represent history in a most vital form.

Two records that will certainly stay in my collection. (W.N.W.).

FROM STAGE AND SCREEN

MY FAIR LADY . . . The ALL STARS Play The Exciting Music Of . . . Stereo, PKS 6033.
Interest: Show music.
Performance: Sparkling.
Quality: Sparkling, too.
Stereo: Plenty of definition.

There's surely no need to comment, ese days, on the music from "My Fair ady," the Bernard Shaw-Lerner-Lowe usical that is already a tradition.

You've heard the music played and ng by many artists and many groups ut I'll wager that you haven't heard brighter or more ingenious presentaon than this one by the All-Stars, from e pen of arranger Al Caiola.

It's arranged for dancing but most ill be more content just to listen. And old on to your hats, when you come "Get Me To The Church On Time."

The tracks: "On The Street Where ou Live," "Wouldn't It Be Loverly," Could Have Danced All Night," how Me," "Ascot Gavotte," "With A ttle Bit Of Luck," "You Did It," "Just ou Wait," "Get Me To The Church n Time," "Without You," "The Rain Spain," "I've Grown Accustomed To er Face."

It's good musically and good technicy. Another one I can heartily recomend. (W.N.W.)

★ ★ ★

UT BEAUTIFUL." Bing Crosby. Songs from the Paramount films "Welcome Stranger," "Road To Rio," "The Emperor Waltz" and "Variety Girl." Universal Record Club 12-inch Mono, UC-640.
Interest: Bing favourites.
Performance: Inimitable.
Recording: Old but good.

Those with fond memories of the 47-8 movies made by Bing will no ubt like this disc, featuring the songs m the four films listed above. My ly disappointment when listening to was to find that the "My Heart Is A bo" track is taken from the first time Bing sings it in the picture, rather tnan the second time — when he is joined by Barry Fitzgerald. It would have been just that much better to have a little reminder of that fine old actor . . . Still, this is hardly a criticism of a disc featuring Bing, I admit.

The tracks are "Smile Right Back At The Sun," "As Long As I'm Dreaming," "My Heart Is A Hobo," "Country Style," "Experience," "Apalachicola, Fla.," "But Beautiful," "You Don't Have To Know The Language," "Friendly Mountains," "I Kiss Your Hand, Madame," "The Kiss In Your Eyes," "Emperor Waltz" and "Tallahassee."

The recording is a little limited in range, both tonally and dynamically, as one would expect, but it certainly needs no excuses.

Recommended for Bing fans particularly. (J.R.)

★ ★ ★

GOLDEN THEMES FROM HOLLYWOOD—Liberace. Coral (Festival), 12-inch stero, SCL-931,531. Also on mono, CL-31,531.
Interest: Liberace, film themes.
Performance: Polished, enjoyable.
Recording: Excellent.
Stereo Quality: Smoothly spread.

The latest release from Liberace features twelve top movie tunes of recent years, played in his usual polished and enjoyable fashion.

The tunes are "More" (from "Mondo Cane"), "Charade," theme from "The V.I.P.s," Theme from "Exodus," "Days Of Wine and Roses," Theme from "Women Of The World," Theme from "A Summer Place," "Maria" (from "West Side Story"), "Moon River" (from "Breakfast At Tiffany's"), "Never On Sunday," "Till There Was You" (from "The Music Man") and "Irma La Douce."

The recording is excellent in all respects, and the disc can be highly recommended to Liberace enthusiasts.—(J.R.).

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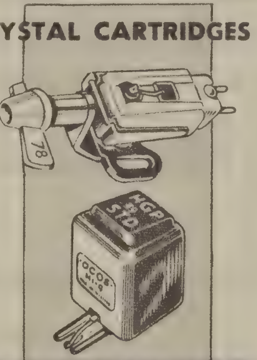

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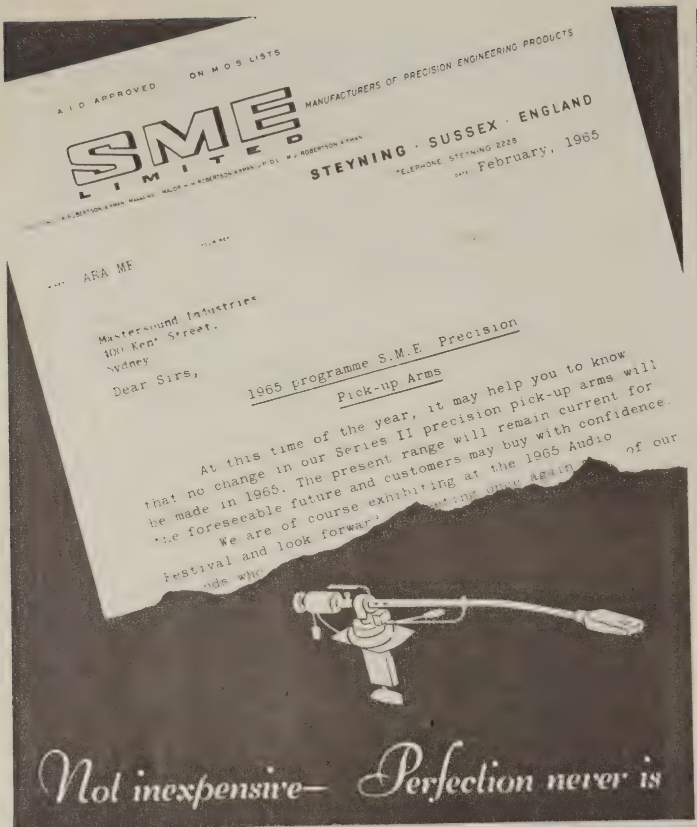
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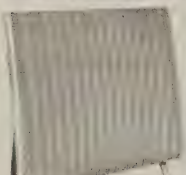

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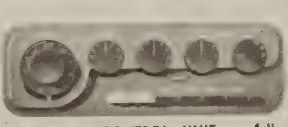

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MOZART SERENADES. The Chamber Orchestra of Lausanne, conducted by Victor Desarzens, Universal Record Club 12-inch stereo, SUC-575.
Interest: Mozartian cheer.
Performance: Sprightly.
Recording: Excellent.
Stereo Quality: Well spread.

On this disc are two of Mozart's best loved serenades, the No. 9 in D major, K.320 or "Posthorn" and the No. 6 in D major K.239 or "Serenata Notturna." The former gets its name from the inclusion in the latter part of the sixth movement of a short obbligato on the posthorn — a short coiled semi-conical horn once used on stagecoaches.

Playing these delightful pieces is the Lausanne Chamber Orchestra of Switzerland, who play them with sprightliness and enjoyment. They are conducted by their director Victor Desarzens.

The recording is of excellent quality, with low noise, very low distortion and good tonal balance. The stereo is well spread and without exaggeration.

A fine disc for U.R.C. Mozart lovers (J.R.)

* * *

TANGO DE LUXE. The Tokyo Cuban Boys plus Guest Stars. Conducted by Tadaaki Misago. Stereo King (Festival) SFL-931,572.
Interest: Bright music, hi-fi sound.
Performance: Really keen.
Quality: None better.
Stereo: "Three-channel" variety.

This is another one of those Japanese King records that make you sit up, from the very first bars. The sound is full, ye cleanly defined; the stereo gives a strong 3-channel effect, with clear definition o the sound groups, yet without a sense o gimmickry; and the playing is of th highest quality, each entry bold and concise, yet never at the expense o ensemble.

Over and above this, tango theme are usually easy on the ear and thes are no exception: "El Amancer," "E Huracan," "Adios Muchachos," "Yira Yira," "La Morocha," "Inspiracion," "Adios Pampa Mia," "Canaro En Paris," "Mama Yo Quiero Un Novio," "L Cumparsita," "Caminito," "A Media Luz."

For tuneful, hi-fi stereo, recommended (W.N.W.)

* * *

HOLIDAY IN SPAIN. Fourteen Spanish pieces by various performers H.M.V. "Music Of The World" 12-inch mono, OCLP-1769.

HOLIDAY IN GREECE. Twelv Grecian pieces by various performers. H.M.V. "Music Of Th World" 12-inch mono, OCLP-1771
Interest: Travel, reminiscence music
Performances: Authentic.
Recording: Very high quality.

Musical tours through contemporar Spain and Greece are presented on thes discs, which come from H.M.V.'s serie "Music Of The World." Other discs i the series take the listener through Italy France, Germany, Austria and Switzerland (the two last-named on one disc).

To list all the performers would tak more space than I have available, bu here are the pieces played.

On the first disc, "El Gato Montes," "Santa Margarita," "Alegrias, "Recuerda," "Refila Pep," "A La Muerte De Juan Belmonte," "La Tarara," "Espana Cani," "Clelito Lindo," "Viva Sevilla Y Triana," "El Porompompero," "Parado De Valldemcsa," "Mi Petenera" and "A Tu Vera."

The disc on Greece has "Mia Neraitha," "Kapio Proino Ston Peraia," "Thelo Aghapi," "Katartia Ston Elio," "Opa Opa," "O Ouranos Einai Kleestos," "Kato Sto Passalimani," "Pou Ghyrizis," "Ti Na Teen Kano Tee Hara," "Fila Me Fila Me," "Rodhia Tetraklone" and "Ton Haro Ton Antamossa."

The playing is lively and the recording is of a very high standard, making the discs very suitable for reminders of a visit to the countries concerned, as pure ersatz, or perhaps as nostalgic reminders to those long parted from their native lands. For any of these "applications," recommended. (J.R.)

* * *

I WISH YOU LOVE — Andre Kostelanetz and His Orchestra. CBS 12-inch stereo, SBP-233152.

Interest: Popular orchestra.
Performance: Usual Kostelanetz.
Recording: Excellent.
Stereo Quality: Good.

Kostelanetz' fans will no doubt be interested in his new disc, with its collection of old and new tunes given imaginative arrangements and smooth performances.

The tunes played are "Fools Rush In," "Maria Elena," "Hello, Dolly!," "Deep Purple," "I Will Follow Him," "Blue Velvet," "I Wish You Love," "Java," "Shangri-La," "Bluesette," "Ebb Tide," and "The Fall Of Love" . . . certainly a most varied and interesting selection.

The recording is excellent in all respects, and the stereo is well and smoothly spread. (J. R.).

* * *

THE INCOMPARABLE MANTOVANI and His Orchestra. Decca FFRR 12-inch stereo, SKLA 4640.

Interest: High power schmaltz.
Performance: The usual polish.
Recording: Excellent.
Stereo Quality: Widespread.

The Mantovani style, perhaps best described as "high powered schmaltz," is well known, and comes in for a fair amount of derision from critics and the self-styled musical elite. However, if one accepts Mantovani on his implicit terms, I don't think one can accord his music anything but praise.

To a large degree, the individuality of the tunes played by the Mantovani orchestra is lost to the all-pervading Mantovani style and this is the usual reason for the derision. So what? If one wants a "straight" performance of any of the tunes, there are plenty to choose from . . .

No, it's his own style that Mantovani is selling, and to my mind he does a fine job of it — his records and TV programs have been extremely popular.

Am I just saying that it's good because the mob like him? I'll leave that for you to work out; but the much maligned Mantovani style seems to me to qualify pretty well for the hackneyed phrases "interpretive distortion" and "unifying element expressing the restless striving of humanity" and much of the similar-sounding tripe written about the more self-conscious type of art. It's just possible that it's because of this that people like Mantovani.

On this disc tunes played (or used, if you like) are "I Wonder Who's Kissing Her Now," "As Time Goes By," "Catch A Falling Star," "Where Are You," "(I Left My Heart) In San Francisco," "I'll Be Seeing You," "Yesterdays," "Fly Me To The Moon," "I'll Get By," "September In The Rain," "Long Ago" and "More." And very pleasant listening it makes too, when you're in the mood.

The recording is of excellent quality, and the stereo is widesppread. Recommended. (J.R.)

* * *

MARCHING WITH THE GRAND MASS BANDS. Conducted by Harry Mortimer, O.B.E. The Combined Bands of Fairey's, Foden's and B.M.C. Mono, Colombia 330SX 1652. (Also Available in Stereo SCXO 3520).

Interest: Marches for marching.
Performance: Excellent.
Quality: Excellent.

If your collection lacks a good brass-band recording, this could be the one for you. With three of England's best-known bands co-operating under the baton of Harry Mortimer, it ought to be good—and it is!

Included in the fourteen titles are several tuneful old chestnuts but, more than that, the titles cover a variety of composers and styles.

Mind you, style notwithstanding, there's a certain sameness about the sound of a brass band which may deter you from listening right through the fourteen tracks, too many times, but they're all good tracks, which will intersperse readily through other items you might want to play.

The titles: "Blaze Away," "El Abanico," "Marching Sergeants," "King Cotton," "March Of The Slide Trombones," "Trafalgar," "The Churchill March," "Imperial Echoes," "Quand Madelon," "El Capitan," "Bright And Early," "Entry Of The Gladiators," "Out Of The Blue," "Broad Highway."

Quality wise, the mono version submitted for review was excellent and I have little doubt that the stereo version would be equally commendable. — (W.N.W.).

* * *

BACH ORGAN MUSIC. Jeanne Demessieux playing the organ of the Victoria Hall, Geneva. Decca Ace of Clubs 12-inch mono, ACL-242.

Interest: Classic organ.
Performance: Warm, sensitive.
Recording: Excellent.

An excellent bargain for organ lovers, this disc, for it features the not-so-widely known virtuoso Jeanne Demessieux playing some fine Bach on the splendid Victoria Hall organ and is on Decca's economy label.

The pieces are somewhat varied Bach. There is the splendid and bright Toccata, Adagio and Fugue in C major (BWV 564), with its ornate toccata, peaceful adagio, sombre grave and cheery little fugue; the lovely little chorale-prelude "Wenn wir in hochsten Noten sein" (BWX 651), from the "Little Organ Book;" trio-like chorale-prelude "Jesus Christus, unser Heiland" (BWV 626); passionate chorale-prelude "Nunn komm' der Heiden Heiland" (BWV 599); that bright little gigue the "Fugue in G major" (BWV 577) and finally the somewhat bombastic and well-known "Prelude and Fugue in A minor" (BWV 543).

Demessieux plays the pieces sensitively, warmly but precisely, and without haste; registration is apt, being appropriate to the music and parts while showing evidence of care taken to avoid the trap

(Continued on Page 101)

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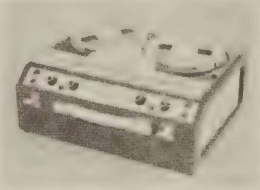

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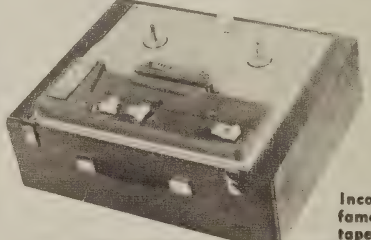

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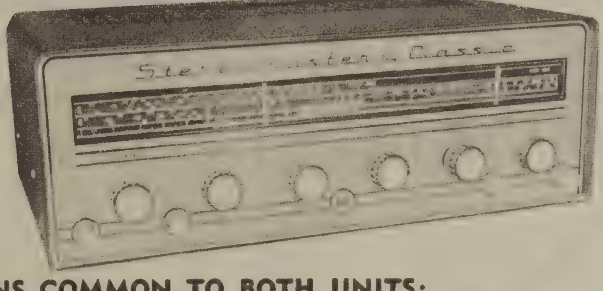

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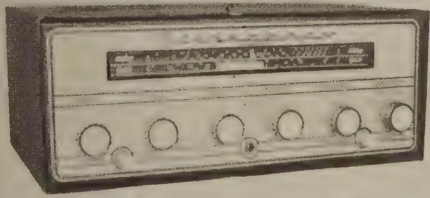

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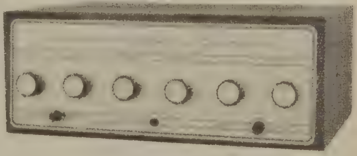

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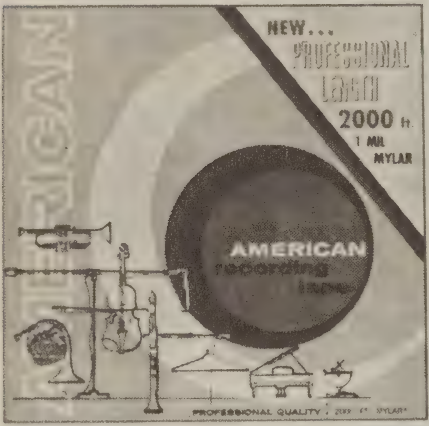

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VARIETY FARE - Cont.

of smothering the upper part with "solid" but blaring bass or too many bass mutations. The parts are generally kept clearly apart and "free."

The recording is excellent. A bargain disc that can be thoroughly recommended. (J. R.)

* * *

MORE FANTASTIC SOUNDS OF EDDIE BAXTER at the Lowrey Organ. Stereo, Dot (Festival) SZL-931-556. (Also available in mono ZL-31-556).
Interest: Popular organ.
Performance: Tops.
Quality: Good.
Stereo: The 3-channel variety.

This disc is well named, because the sounds that Eddie Baxter wins from his Lowrey organ border indeed on the fantastic. Out of its electronic circuitry come the voices of bass clarinet, oboe, trombone and flute, the latter quite startling in its projection. Then there's a harp sound, marimba, zylophone, birds, monkeys, assorted tropical noises and a steam train.

Yes, Eddie Baxter is good but not so good that the performance doesn't benefit tremendously from some very lively percussion, which doesn't even get a mention.

THEY play: "Cucamonga Choo Choo," "Walk On The Wild Side," "The Girl From Ipanema," "Nightingale," "Street Of Dreams," "Hello Dolly," "Stormy Weather," "Sweet Georgia Brown," "Stella By Starlight," "Satin Doll," "When Joanna Loved Me," "Andalucia."

One for organ and/or rhythm fans. (W.N.W.).

* * *

AS TIME GOES BY. Liberace, Piano, with Violin and Percussion. Stereo, Universal Record Club SUP-511.
Interest: Liberace for lunch.
Performance: Routine.
Quality: Standard stereo.
Stereo: Normal.

Noted among the Universal Club's bonus records was this Liberace disc not previously reviewed in these columns. It's typical enough Liberace fare, perhaps not quite as lush as some of the performances I've heard, but still full of runs and ornamentation, plus interludes by a violinist who doesn't rate a mention by name.

I can't imagine any but Liberace enthusiasts sitting down really to study the performance, though most would accept it quite happily as music for dining and relaxation.

The track titles: "Terry's Theme," "It's All In The Game," "I'm In The Mood For Love," "Don't Take Your Love From Me," "Love Is Like A Violin," "Someone To Watch Over Me," "As Time Goes By," "Misty," "September Song," "Sleepy Time Gal," "These Foolish Things," "My Melancholy Baby."

Technically the quality is normal stereo except for one thing: If you have keen ears you will note a faint 1,000cps background through side 2, most noticeable in the break between tracks. Stylus whistle or did someone leave an oscillator running? (W.N.W.)

* * *

THE MELLOW GUITAR MOODS OF LOS INDIOS TABAJARAS (The Indians). "Marta," "Sunrise Serenade," "Nunca," "Always," "Mapuche Boy," "Lovely Weather," "St. Louis Blues," "Adios Mariquita Linda," "Please," "Amor," "A very Precious Love," "Angelitos Negros." R.C.A. "Dynagroove," Stereo. LCP-2959.
Interest: Melodious guitar.
Performance: Smooth.
Quality: Excellent.
Stereo: Even spread.

Those who enjoyed the previous LPs of "The Indians" will find on this disc a dozen odd numbers played in the same smooth style—simple melody on the top, solid and sometimes exotic rhythm at the bottom, and sweet, simple chords in between.

This is music to relax or unwind with, in fact, music for an evening of doing nothing in particular. And you need have no fears about the audio quality—it is absolutely first class with a nice even stereo spread. (K.W.J.)

PRE-RECORDED TAPE

FIESTA. Charles Magnante, His Accordion and Orchestra Go South Of The Border. Pre-recorded tape, 4-track, 7½ips, stereo, Command RS 4T 869.
Interest: South American accordion, percussion.
Performance: Top-line.
Quality: Flawless.
Stereo: Outstanding spread, definition.

Having reviewed the record as recently as March this year, it was with particular interest that I received this pre-recorded tape of the same material, thus allowing for direct comparison. What is more, I had rated the record for quality and stereo in the exact words used above and might therefore be embarrassed for want of different or stronger adjectives.

Replay through the same basic amplifier and loudspeakers, but with different—and supposedly flat—input systems showed the tape as having more sparkle at the top end and more precise separation, though the significance of the latter was largely academic, since separation was adequate in both.

On the debit side, the tape sounded rather more empty in the middle register and the system as a whole exhibited slight but perceptible hiss, which was not apparent in the disc system.

In terms of listener preference, I imagine that opinions would divide about evenly, some preferring the tape as "rather more spectacular," others the disc as "somewhat better balanced." Technically, it probably adds up to a difference in overall equalisation and, with this adjusted, the choice would hang on marginally cleaner treble from the tape system versus marginally lower noise from the disc system, with each rating very high, nevertheless.

The track titles, again: "El Cumbanchero," "La Paloma," "Malaguena," "Jungle Drums," "Amapola," "Brazilian Nocturne," "Ritual Fire Dance," "Rosita," "Carmen Opera Melody," "Cielito Lindo," "A Gay Ranchero," and "Yours."

A good tape. (W.N.W.)

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RUSSIAN FAIR — DON COSSACK CHOIR. Serge Jaroff, conductor. Universal Record Club 12-inch stereo, SUM-598.
Interest: Russian male choir.
Performance: Vigorous.
Recording: Good.
Stereo quality: Fine.

A fine disc for those who would like a record of songs by what is perhaps the finest and best-known expatriate Russian choir. The singing is vigorous and warm, yet quite disciplined.

The songs are "At A Russian Fair," "Song Of The Cadets," "The Birch Tree," "Glory To Him," "After The Battle," "Lilacs In Bloom," "A Gypsy Campfire," "A New Year's Tale," "Christmas Night" and "Soar Like Eagles."

The recording is at a rather low level, tending to make surface noise a little more obvious than usual, but apart from this it is fine. The stereo is well spread. (J.R.)

* * *

SING OUT ON THE BEACH. The Troubadour Singers sing the big folk music hits. Arranged and Conducted by Jim Helms. Young World (World Record) 12-inch stereo, SYH-1515.
Interest: "Folk" hits.
Performance: Top-notch.
Recording: Excellent.
Stereo Quality: Slightly exaggerated.

Since receiving this disc for review I have listened to it about eight or nine times now, and I'm really impressed. It's easily the most consistently good folkie recording I've heard to date. Such a change from those discs with one or two really good tracks and the remainder rather mediocre fill-ins—this one maintains a very high quality throughout all the tracks. The arrangements are imaginative and the singing manages to sound delightfully spontaneous while revealing by its precision that considerable rehearsal effort was expended to attain the standard reached. A really top-notch performance on all points.

The songs presented are "Blowin' In The Wind," "Tomcat," "Tzena Tzena Tzena," "Green Fields," "Two-Ten Six-Eighteen," "Sixteen Tons," "One Two Three," "Walk Right In," "Kisses Sweeter Than Wine," "Green Leaves of Summer," "They Call The Wind Maria" and "If I Had A Hammer." Conductor Jim Helms is lead guitarist, with Mason Williams and Jimmy Bond on banjo and bass. They give the singers a solid but sparkling backing.

The recording quality is excellent, with fine tonal balance and negligible noise and distortion. Stereo separation is a little exaggerated for the benefit of those with single-cabinet stereo players, but is otherwise very smooth.

An excellent disc, and highly recommended. (J.R.)

* * *

DINKEY DI!—We Love Singing Fair Dinkum Aussie Songs. The Bush Music Club, 10th Anniversary Album. Festival 12-in mono, FL-31,526.
Interest: Bush Songs.
Performance: Amateurish but sincere.
Recording: Good.

The story behind this disc is the same as that of "Bush Ballads" reviewed last month by W.N.W., except that it was commissioned by Festival especially to mark the tenth anniversary of the Bush Music Club in 1964.

I must confess that my reactions on listening to it for the first time were mixed; further playings have amplified the mixed feelings but not resolved them, so I'll content myself with a few comments which seem appropriate.

Perhaps the first thing to strike one on listening to the disc is that some of the singers are rather lacking in training, or talent, or both—thus the performance tends to be somewhat amateurish. This has the effect of exaggerating the aimed-for "authentic simplicity" almost to the point of farce.

And yet one is also struck with the sincerity of the group, as they are obviously trying to preserve an artform which they believe to have genuine merit. One may disagree with them in this regard either generally or in connection with some of the songs in particular (do they collect and preserve ALL Australian folk-songs? Surely one must exercise some discrimination . . .), but one can hardly doubt their sincerity. They play and sing with a warmth which both testifies to their involvement and also seems to justify their work. In any case, most of the songs make pleasant listening, and apparently they have a wide local appeal.

The songs presented are "Dinkey Di!", "Flash Jack From Gundagai," "Moreton's Bay," "Wallaby Liz," "Little Fish," "Haymaker's Jig," "The Peach Pickers Song," "Jacky Jacky," "Frank Gardiner," "The Great Northern Line," "Gurrawilla," "The Whip And The Spur" and "Polka—Give A Fair Go, Cruck O' The Ark."

The recording is good, so the disc can be recommended if the music is to your liking. (J.R.)

* * *

THE SPINNING WHEEL. Kathleen McCormack Sings Irish Songs. "The Spinning Wheel," "Three Lovely Lasses," "I Know Where I'm Going" and "The Whistling Gypsy." RCA 7-inch mono EP, 20325. DEAR LITTLE SHAMROCK — John McCormack. "Dear Little Shamrock," "Because," "When You And I Were Young, Maggie," "Mary Of Argyle." RCA Gold Standard 7-inch mono EP, 20326.
Interest: Oirish songs.
Performance: Well loved.
Recordings: High quality.

Two little discs of the Oirish sorngs, me dears, song for os bye those two foine singers from the auld contrie, Kathleen McCormack and John McCormack. And they're so well known, the songs and the singers, me dears, that I need comment no forther.

If ye need to know, the recordings are good. The John McCormack recording is somewhat restricted in range, o' course, but foine none the less. (J.R.)

* * *

CHEERS with TESSIE O'SHEA—London's Great Entertainer. Recording Originated and Produced by Enoch Light. Command, Stereo. SNDL-931,576.
Interest: English Music Hall.
Performance: Sparkling.
Quality: Excellent.
Stereo: Nice wide spread.

Tessie O'Shea has been hailed as "the greatest of all entertainers to come out of the English music halls." I can't quite agree with this statement — its a little too broad for my liking — but I do think Tessie is probably one of the best from the music halls.

Tessie O'Shea (nicknamed "Two-Ton

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MODEL TD135

A professional turntable featuring a precisely machined turntable and a special inbuilt levelling device a single control knob for the on-off switch and the four speeds, and the unique Thorens two-step drive system to eliminate vibration.

ONLY £62

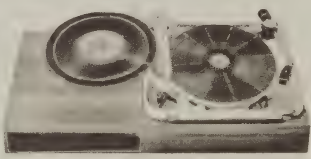
Enjoy the advantages of an elaborate transcription turntable without any isolation problems. The new Professional type tone arm BTD-12S is mounted as an integral part of the TD135 turntable. A precise, secure and easy to use rugged instrument, the BTD-12S is specially adapted to guide cartridges of the highest lateral and vertical compliance safely across the record providing minimum inertia, both in the horizontal and vertical planes. Additional features of the Thorens TD135 are the use of Precision Ball Bearings throughout and a convenient integrated arm control for lowering and raising the Pick-up. The stylus force is realised by means of a spring device exerting a torque on the horizontal shaft, which is precisely adjustable through a knob calibrated in grams. Length 15in, width 13 3/16in, depth 3 3/16in, height 3 9/16in, weight, 15.5lb.

BEFORE YOU BUY, COMPARE THE MECHANISM OVER AND BELOW THE UNIT PLATE OF THORENS TURNTABLES WITH ANY OTHER UNIT. YOU WILL ACCEPT NOTHING LESS THAN A THORENS.

THORENS MODEL TD124

The TD124 is unmatched for monophonic or stereophonic sound reproduction. The drive system utilizes an extra compliant belt plus idler wheel to isolate any motor vibration and special shielding of the turntable flywheel, eliminates any induction of stray fields by magnetic pick-up cartridges. The Thorens TD124 also features 4 speeds plus variable speed adjustment control (plus or minus 3 per cent) a 12in 11½lb table with separate non-magnetic shell cover, exclusive Thorens clutch assembly for fast stop and start with no stylus injury. A special Thorens feature is a built in stroboscope enabling speed checks while the record is being played and also acts as a pilot light. The Thorens exceeds NAB specification for rumble, wow and flutter and is sold with one full year's warranty.

ONLY £83



THORENS MODEL TD224

The world's first combined transcription turntable and Automatic Record Changer by Thorens has these many features.

● Speed regularity (wow and flutter content) and rumble level (horizontal and vertical) exceed NAB standards for studio equipment, a 4-speed operation through a long rubber belt low speed stepped pulley and idler wheel drive system. ● Patented variable speed control (plus or minus 3 per cent) with high precision illuminated stroboscope. ● Precisely machined, non-magnetic 12in turntable, weight 7lb. ● Professional type BTD-12S Tone Arm with stylus positioning slide, balancing counterweight and precision-calibrated stylus force adjustment. Low inertia and very low bearing friction. Low frequency resonance below 10 CPS for high compliance cartridges. ● Plays automatically up to 8 records (¾in stack). ● Intermixes records of any diameter between 7in and 12in. ● Records cleaned during play by means of a built-in continuous cleaning device mounted on the record feed in arm. ● Can be operated manually.

ONLY £140

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Tessie" after a number she helped make famous) is a bouncy, big girl, somewhat like a cockney Sophie Tucker in her vocal delivery but without the husky sexiness which Sophie exudes.

The numbers she does are: "I've Got A Lovely Bunch Of Coconuts," "Maybe It's Because I'm A Londoner," "It All Belongs To Me," "Lily Of Laguna," "When You Come To The End Of A Lollipop," "It's Men Like You," "I've Got Sixpence," "Don't Have Any More Missus Moore," "Two-Ton Tessie," "The Honeysuckle And The Bee," "Joshu-Ah," "Hold Your Hand Out, Naughty Boy."

Tessie's sparkling, lighthearted style is marred in places by Enoch Light's rather heavy backing but she really shines in the numbers she backs herself on the banjolele — an instrument with ukelele fingering and a banjo sound.

The audio quality and stereo spread are typical Command standard — really excellent. (K.W.J.).

Popular Jazz

PLAY BACH No. 4. Jacques Loussier (organ and piano) with Pierre Michelot (double bass) and Christian Garros (drums). London-Globe 12-inch mono, HAA 7754.

Interest: "Swung" J. S. Bach.
Performance: Intriguing.
Recording: Fine.

It's not clear just where this disc and its review should be placed—here or in the earlier section. With music by J. S. Bach but arrangements and playing by a modern jazz group, it could belong in either place.

Speaking not as a jazz fan but as a Bach lover (a naive, non-erudite one, be it noted) from way back, I must say I find it quite intriguing and highly enjoyable. If the first three discs in the series were as good as this, I shall certainly try to get hold of them.

How does one describe the way in which Loussier, Michelot and Garros make the music "swing" but still keep it Bach? Well, their arrangements (by Loussier) and playing are related to the original pieces like an impressionist painting to the original scene—only the musical painting is a sort of dynamic impressionism, seeming to use inversion, altering of phrasing, tempo changes and other established "jazzing up" techniques to somehow distil from the Bach its essential feeling.

Usually the piano or organ roughs in the basic outline of the original melody, then all three players embark upon the working-out of various key elements; accentuating, unravelling, reworking, and as it were "adding asides" in comment. Quite often the result is really fascinating, not only for its technical skill, but for the degree of perception into the original which it reveals. In one or two places it seems to almost "out-Bach Bach."

The works upon which the disc is based include the Fantasia and Fugue in G Minor BWV 542 and the Chorale Prelude "Sleepers, Wake, a Voice is Calling," BWV 645.

Technically, the recording is fine. A mono disc, it is free from distortion and noise and well balanced tonally.

For modern jazz fans and those "long hairs" who, like myself, have a love of Bach unburdened with a pedantic purism, this disc will be irresistable. It's a beauty. (J.R.) ■

TRADE REVIEWS AND RELEASES

PROGRAMMED COURSE FROM I.C.S.

International Correspondence Schools have recently released a new course on electronic fundamentals based on "Programmed Learning." The course, to be known as the "PL-100", should prove to be a most effective and important aid for industrial training. A full copy was submitted for our appraisal and review.

THE new course is based on the method of instruction adopted by "teaching machines" which are now undergoing close scrutiny by education authorities all over the world. This interest in teaching machines and programmed learning is significant to correspondence education, because of the common elements in the two approaches to teaching.

Both methods are based on the concept of self instruction, the basis being that individuals can learn without the presence of a human instructor, provided they are supplied with properly designed instruction material.

With the teaching machine, a mechanical/electrical device, there is provision for interaction between the student and the machine so that the student actively participates in his learning. The machine constantly tests the student on new concepts as they are presented and the student's rate of progress is determined by his correct (or otherwise) answers to the machine's questions.

In conventional correspondence education, this individual participation is provided by self-examination questions at appropriate stages and by test papers which the student submits to the school at regular intervals. The corrected papers, returned to the student, take the place of the immediate answer-check supplied by the machine. The objective of both systems is to ensure that the student understands one set of facts before progressing to the next stage.

The major difference between the two methods lies in the frequent and immediate answer checking provided by the machine, as against the considerable time which a student must wait before receiving results through the mail in normal correspondence courses.

In an effort to overcome this problem, ICS have devised a new system of programmed learning which will eventually be applied to many of their courses but which is being offered first in this course on electronic fundamentals. I.C.S. claim that the course will provide: (a) a good fundamental knowledge of electronics; (b) a sound basis for further study in specialised branches of electronics; and (c) an economical and effective training program for employees whose work calls for a knowledge of electronic fundamentals.

The I.C.S. Programmed Course would seem to be the logical development of conventional correspondence tuition.

Both are based on a series of progressive lessons; both require the active participation of the individual. But whereas the efficiency of the correspondence course is governed jointly by the content of the printed lessons and the ability of the tutors to teach by correspondence, the success of the Programmed Course depends entirely on the manner in which the subject is presented, and the number of progressive stages or frames into which the course is divided.

It is important that these stages should be designed to enable the student to grasp one set of facts before passing to the next frame. Thus the "learning" part of the course is made up of small and easily assimilable steps, designed to test progressively the student's understanding of what he has read, stage by stage.

With the I.C.S. course, this is done by combining printed manuals for the student to study and a series of programmed frames containing directions and questions based on the subject matter of the manuals. These frames provide an immediate check on the accuracy of the answers given by the student, the correct answer being contained in the following frame.

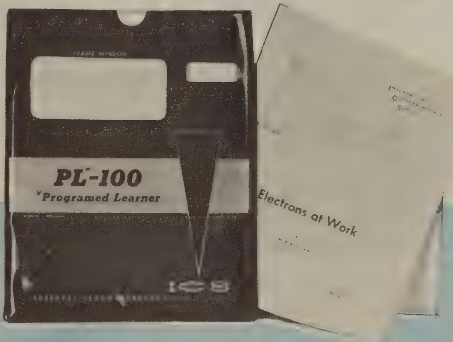
If the answers given are correct, the student proceeds to the next set of questions; if the answers are incorrect, he is referred back to the manual for further study. Each step is arranged in logical planned stages from the elementary to the more advanced aspects of the subject.

The I.C.S. PL-100 course comprises some 20 instruction manuals plus 20 programmed lessons, each lesson containing 300 to 500 self-instruction frames, and a specially designed vinyl envelope into which the programmed lessons are placed as required.

By withdrawing the top sheet of each lesson, frame by frame, the student is given instructions on what to study. Each lesson is divided, or programmed, into stages of one or more paragraphs which explain a single aspect or process.

The PL-100 "envelope" holds all the programmed lessons for each set of manuals and, as each sheet is withdrawn, the next one is found immediately underneath. As each sheet is withdrawn, it is reinserted behind the others so that the reverse sides of the sheets, which are also programmed, are in the correct sequence for study.

The course consists of: Introduction to Electronics (for reference only) Electrons at Work, Electric Circuits and Ohm's Law, Magnetism and Electro-Magnetism, Wiring and Soldering, Theory of Alternating Currents, Direct-Current Networks, Inductance and Capacitance, Transformers in Radio and Electronics, Motors and Generators in Electronics, Resonant Circuits, Radio Communication Fundamentals, Vacuum Tube Fundamentals, Batteries and Electronic Power Supplies, Audio-Frequency Amplifiers, Radio Frequency Amplifiers, Transistors and their Applications, Superheterodyne Receivers, Electrical Measurements in Radio Servicing, Voltage and Current Tests, Point-to-Point Resistance Tests, Cathode Ray Oscilloscope in Electronic Servicing.

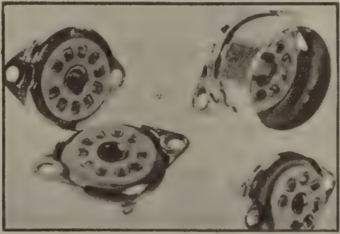


The PL-100 course appears to be well written, clear and concise in its definitions and with all fundamentals adequately covered. It lends itself ideally to individual study at home or in organised classes, and caters both for the slow and quick student — since the individual controls his own rate of progress. It would be particularly suited to those who cannot undertake a normal home study course with numerous written exercises and would provide these people with an ideal method of training in electronic fundamentals.

The course is available with or without a final written examination for a certificate from the school, but further inquiries on this and the price of the course should be directed to International Correspondence Schools, 400 Pacific Highway, Crow's Nest, N.S.W. ■

NEW CERAMIC VALVE SOCKETS

Ducon Industries Pty. Ltd. announce the release of a wide range of ceramic valveholders manufactured by Plessey, U.K. All the valveholders use a specially developed ceramic body material which has excellent electrical characteristics with good performance under extremes of temperature and humidity.



Standard ratings and electrical data for a typical socket in the range are as follows: Maximum contact current—1 ampere; maximum working voltage—2000 volts; contact resistance—0.004 ohm; capacitance (adjacent contact) 0.6pF; insulation resistance (damp heat at 500 volts)—1 million megohms; minimum contact retention—3oz.

Sockets available at present are 7 and 9-pin miniature types in a wide variety of different saddle, spigot and mounting styles. Associated accessories for the sockets include valve screening cans and valve retaining clips. Valveholders for professional equipment and specification approved Post Office styles are available to order.

All the valveholders are competitively priced and many are available at prices below that of contemporary ceramic types. Further inquiries should be directed to Ducon Industries Pty. Ltd. of Villawood, N.S.W. ■

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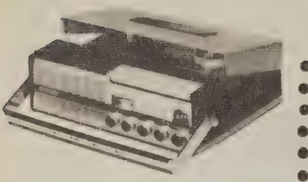

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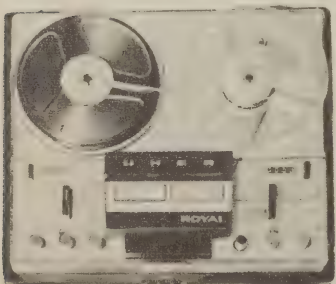

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VIC.: ATRAM PTY. LTD., 28 Wellington Street, ST. KILDA, VICTORIA Telephones: 51-4466: 51-4577.
S.A.: KALLIN DISTRIBUTORS (WHOLESALE) LTD., 140 Gawler Place, ADELAIDE, SOUTH AUSTRALIA. Telephones: 8-7171 (11 lines).
W.A.: MUSGROVE'S LTD., 223 Murray Street, PERTH, W.A. Telephones: 21-6611 (8 lines).
Q'LD.: A. E. HARROLD PTY. LTD., 123-125 Charlotte Street, BRISBANE, Q'LD. Telephone: 31-3081 (10 lines)

DESK MICROPHONES BY TURNER OF USA

Pictured is the model 254C, one of the range of desk microphones manufactured by the Turner Company of Cedar Rapids, Iowa, U.S.A. A companion microphone, the 253, was sent to our office recently for review by the importers, Hodges Sound Systems.

THE series of microphones which includes the 253 and 254C are streamlined desk types having a large press-to-talk key and an associated locking lever. They are housed in a light but rugged die-casting, finished in silver-grey hammertone, with chrome trim and four soft rubber feet to prevent damaging the surface upon which they are placed. The key switch features contacts available for transmitter or amplifier switching. A seven-foot length of cable is supplied with the microphones, being captive at the microphone end.

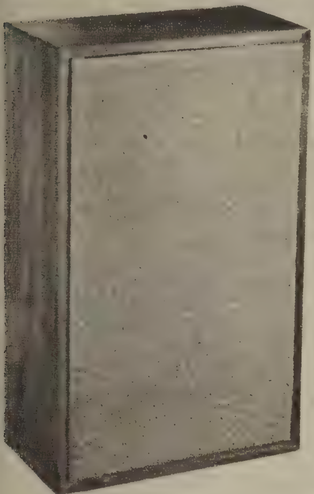
As judged from the unit sent for review the microphones would seem to be extremely well made, medium-fidelity types, suited particularly to public address, communications and recording work. Their ruggedness would make them very suitable for commercial use. The operating key is smooth and silent in operation, with simple and straightforward locking by the small lever. The stand is stable and the cable is securely anchored to it. Signal leads in the cable are shielded separately from those used for switching.

The model 253 is a dynamic unit having an output impedance of 50 ohms. It can of course be used with standard step-up transformers to provide any desired signal impedance. The output level is quoted as —52dB, with a frequency response of 60-cps — 10KC. Retail price is quoted as £14/19/.

The model 254C is a ceramic type having a quoted output of —54dB and a response of 80cps — 7KC. Retail price is quoted at £12/16/3.

The usual discount arrangements apply to the trade and radio amateurs, and postage is free within Australia. Pamphlets are available on request from Hodges Sound Systems at 35 Lewis Street, Balgowlah, N.S.W. (J.R.).

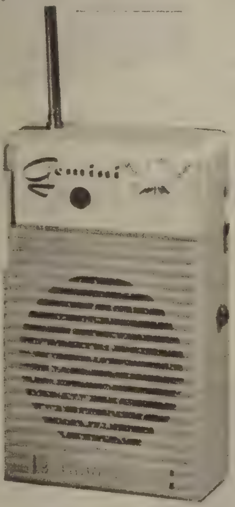
OTHER NEW PRODUCTS



BROADWAY ELECTRONICS sent the enclosure pictured for review and comment. From a recent batch of "Instrol-Playmaster" Bookshelf enclosures, based upon our design of December, 1964, the unit supplied has the popular oiled teak finish.

Although the prototype enclosures produced for this firm (and others) were not sufficiently close to published specifications to obtain our unqualified approval, recent batches have conformed closely to specification, as evidenced by this sample.

Price for a complete kit of parts is £14, and for a complete and tested unit, £17/18/-. Alternatively the cabinet may be purchased alone, as a kit, or assembled. Further details are available from Broadway Electronics Pty. Ltd., E.S. and A. Bank Building, cnr. City Road and Broadway, Sydney.

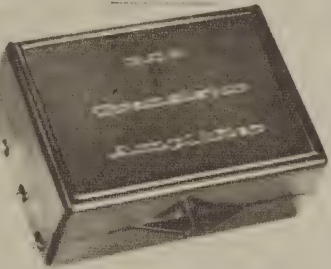


FUJI DENKI CO. market this two-transistor portable radio, which is assembled in Australia from imported components. A "personal" set, it measures only 1½in x 2½in x 4in and is available in a black, grey, turquoise or maroon case. A small telescoping aerial rod is supplied with the set, together with an earpiece for private listening.

On test the little receiver was found to give quite useful performance on several stations, using its in-built ferrite aerial alone in the city and suburbs. It is naturally rather limited in range and selectivity, however, and would scarcely be suitable for use in either difficult or remote areas.

The two-inch speaker gives acceptable performance at moderate personal listening levels. The telescoping rod aerial is largely ornamental, as with most such devices as fitted to broadcast band transistor receivers.

Retail price is quoted as £6/16/6, and enquiries should be directed to Fuji Denki Co., P.O. Box 9, North Geelong, Victoria.

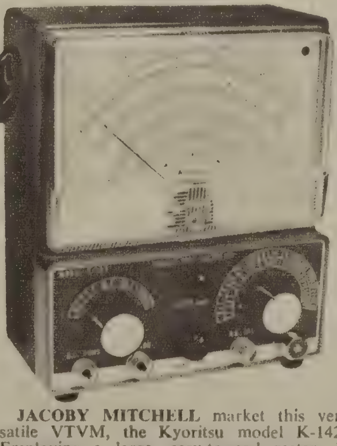


R.C.S. RADIO have recently made available this small four-transistor class-B complementary symmetry audio amplifier, which can be used for record playing, low-power public address, and other applications requiring a compact amplifier unit.

It operates from 9 volts DC and will deliver a maximum of about 1½ watts RMS into an 8-ohm load. With a 15-ohm load the maximum undistorted output power is more than ½ watt. Quiescent current is of the order of 20mA and the unit can be driven directly from a low or medium impedance dynamic microphone. Other sources may require suitable matching resistors.

The amplifier mounts in a plastic box measuring 3in x 2in x 1in, which may in turn be mounted in record players, on a receiver chassis, and so on. Only four connection lugs are used and wiring up is a simple matter due to the use of a coded printed wiring board.

As a kit of parts for do-it-yourself enthusiasts the unit is designated part No. 665 and costs £4/19/ plus 1/ postage. Fully assembled and ready for use (designated then as 665D) is costs £5/15/ plus postage. Enquiries should be directed to R.C.S. Radio Pty. Ltd. at 651 Forest Road, Bexley, N.S.W.



JACOBY MITCHELL market this versatile VTVM, the Kyoritsu model K-142. Employing a large, easy-to-read meter, it provides some 28 measuring ranges and costs £25 plus sales tax. Enquiries to Jacoby Mitchell and Co. Pty. Ltd., 469-475 Kent Street, Sydney, N.S.W. ■

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Meter Ranges: 0-20V. D.C. 0-20mA. 0-200mA. 240V, 50cps. mains operated.

COMPLETE £13/13/-
Post 5/, interstate 7/6.

MINI-LAB 7in 1 MULTIMETER

Resistance Substitution. ½W., 5%, 100, 1K, 10K, 100K, 1 megohm. Capacitance Substitution: .002, .005, .02, .1(oil600v) and 10uf. R.F. Signal Generator: 455kc. at 35mV. Audio Generator: 400kc. (approx.) 35mV. DC and AC Volt ranges: 0-15, 0-50, 0-150, 0-500. R.F. Field strength: 1-140mc. Antenna: 5 section 10¾in. Sizes: 6in x 2¾in x 3⅜in. Battery operated.
COMPLETE £9/7/6.
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TRANSISTORISED. SIGNAL INJECTOR

2 Transistor. Osc. Voltage 1.5 to 2v. P-P Freq. 400-700cps. plus harmonics.
Price 52/9, Post Free.

TRANSISTORISED SIGNAL TRACER

Gain: over 70dB. Gain control: continuous from 0. Attenuation factor: 0-20-40-60. Input Impedance: AF: over 70Kohm. R.F.: over 100Kohm. Output Impedance: ext. speaker, 8 ohm output, 600 ohm unbalanced. Meter: VU 200uA. Speaker: 2¼in dynamic. Contains 6 Transistors, 4 diodes, 1 thermistor. Size: 5⅞in x 3⅜in x 2¾in. Battery: 9V, 006P.

COMPLETE £13/10/6.
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20,000 ohms/volt MULTI-METER (push button)

D.C. volts: 25, 50, 500, 2,500 A.C. volts: 10, 100, 1,000. D.C. Current: 0-50uA, 0-250mA. Resistance: 60K, 6 megohms.
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MEASURES

Ico (IcBo) and reverse current of diodes. 0-150uA (1uA per scale) on GENERAL POSITION. 0-1mA (20uA per scale) on POWER POSITION. Beta 5-200 (2 per scale). BIAS CURRENT (1mA on GENERAL POSITION. 5mA on POWER POSITION). Alpha 9-0.995. Ico equals plus or minus 3 per cent of full deflection. Beta and Alpha equals plus or minus 3 per cent of value indicated. METER equals 50uA F.S.D. BATTERY OPERATED, equals 6v (4 UM3). Equals 1.3 (Mercury). Size 7⅛in x 4⅞in x 3in.

COMPLETE £16.
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MULTIMETER TESTERS

EXCLUSIVE TO RADIO HOUSE PTY. LTD. **Phone 26-2817.**

Model RH-114

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4,000 Ohms/V Multimeter

FEATURES

All 1 p.c. precision resistors.
Small and light weight for convenience.
Wide ranges of measurement, with high accuracy.
Complete with test leads and batteries.

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Sensitivity: 2,000 Ohms per Volt DC and AC.
Ranges: DC Voltage: 0-10-50-250-500-1000V.
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DC Current: 0-10, 0-250 mA.

Resistance: Ranges	Centre Scale
0-20,000 Ohms	200 Ohms
0-2Megs.	20,000 Ohms

Decibels:—20—22dB. 20-36dB. (0db 1mW into 600 Ohms).
Dimensions: 3¼" x 4¾" x 1¾".
Net Weight: 0.9lb.

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Modern Design, 33 Micro Amp Meter.
30,000 Ohms per Volt D.C.
13,000 Ohms per Volt A.C.
1 p.c. Multipliers and Shunts used.
Printed circuit.
Clear Scale, rugged moulded case.

SPECIFICATIONS

DC Voltages: 0-0.3-1.2-3-12-30-120-300-600-1,200 V at 30,000 Ohms per volt.
AC Voltages: 0-3-12-30-120-300-600-1,200 V at 13,000 Ohms per volt.
DC Current: 0-.06-6-60-600 mA, 0-12 A.
Resistance: 0-60K-6M-60M (350, 35K, 350K at mid-scale).
Decibels: minus 20 to plus 57 dB (O dB equals 1 mW. 600 ohms).
Audio Out: Capacitor in series with AC volt ranges.
Short Test: Internal buzzer.
Accessory: 1 pr. heavy test leads.

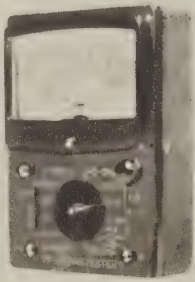
Price £15/10/-

Post 5/- to 10/- extra

Batteries: 1 (1.5V), 1 (15V).
Size: 3 5-16" x 6 5-16" x 2¾"
Weight: 1.4lb approx.

LIMITED STOCK ONLY

Model RH-10



RANGES:

DC Voltages: 0-10-50-500-1,000 V at 2,000 Ohms V.
AC Voltages: 0-10-50-500-1,000 V at 2,000 Ohms V.
DC Current: 0-500uA 0-500 mA.
Resistance: 0-10K-1 Meg: 60 ohms, 6 Kohms at centre scale.
Capacitance: 250uuF to 1uF, in two ranges.
Decibels:—20 to plus 36db, two ranges.
Output: 0-1,000 V in four ranges.
Size: 5in x 3½in x 1½in.
Weight: 13oz approx.

Price £5/7/6

Postage 5/- to 10/- extra.

Model RH-5

- High sensitivity-20,000 Ohms/V DC, 10,000 Ohms/V AC.
- 3in Meter.
- Handy pocketable size.

SPECIFICATIONS

DC Voltages: 0-10-50-250-500-1000 V (20,000 Ohms/V).
AC Voltages: 0-10-50-250-500-1000 V (10,000 Ohms/V).
DC Current: 0-50uA, 0-5-50-500mA.
Resistance: 0-10K, 0-100K, 0-1Meg, 0-10Meg. (62 Ohms, 620 Ohms, 6.2K, 62K at centre scale).
Capacitance: 0.0001uF-0.005uF, 005uF-1uF.
Decibels: minus 20db to plus 36db in 2 ranges.
Dimensions: (3½" x 5¼" x 1¾").
Weight: 15oz approx.
Complete with internal battery, testing leads with prods.

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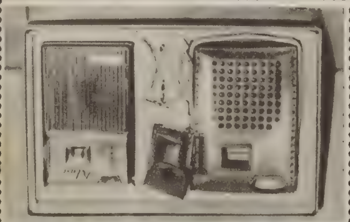

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AMATEUR BAND NEWS AND NOTES

The W.I.A. 29th Federal Convention

Delegates from all States in the Commonwealth met in Melbourne over Easter to express views and discuss plans for the continued advancement of Amateur Radio in Australia.

By Pierce Healy, VK2APQ *

AT 2 p.m. on Good Friday afternoon, April 16, delegates representing all divisions of the Wireless Institute of Australia assembled at the rooms of the Victorian division, 478 Victoria Parade, East Melbourne, to attend the 29th Federal convention.

The Wireless Institute of Australia is the oldest amateur radio society in the world. Its formation goes back to 1911 and, in recent times, it has been considered expedient to hold a convention each year.

The organisation structure of the Wireless Institute of Australia is for each State to elect a representative known as the Federal councillor to attend such conventions to express the views of his division and, jointly with the other Federal councillors, prepare plans and resolve differences of opinions. From these discussions, directives are given to the Federal executive to approach and negotiate with the P.M.G. Department and kindred radio societies throughout the world.

Matters affecting the well being and advancement of amateur radio in Australia, both from a scientific aspect and as a service to the community are among the subjects discussed by delegates.

The Federal executive is a non-voting committee elected in accordance with the present Federal Constitution from members of the Victorian division. This arrangement allows easier contact between W.I.A. officers and senior officers of the P.M.G. Department.

Being held in Melbourne this year, the convention allowed delegates to meet new members on the executive and discuss, outside the conference room, matters of mutual interest, in particular the broad outlook of the various divisions.

The total time spent around the conference table during the weekend was 22½ hours. During this period, many matters associated with institute policy, P.M.G. regulations and contests were discussed. The final draft of the proposed new Federal Constitution was given to delegates for consideration and approval by their divisions.

The proposed constitution will not change the basic structure of divisions as they exist today, but is designed to allow a greater degree of unity to be achieved and a speeding up of the functions of the Federal executive. Also it is to permit activities associated with the production of official institute publications to be taken over by the Federal body.

The British Post Office regulations and their application to the Australian amateur service, in relation to single side band transmissions, were discussed at length.

The subject of novice licences and the advantages to those associated with the youth radio scheme, was another of the points raised.

Disappointment was expressed at the refusal by the Postmaster General's Department to allow technical broadcasts from official W.I.A. stations for the benefit of members of youth radio scheme clubs. This refusal was considered to be a most unrealistic attitude on the part of those in authority, particularly when countries such as the United States of America, U.S.S.R., India, Israel and Communist China gave every encouragement to the youth of their country to participate in activities designed to further their knowledge of radio and electronics.

On Easter Saturday evening the official convention dinner, held at the New Boundary Hotel, East Melbourne, was attended by members of Federal executive, Victorian Division Council, interstate delegates and observers and members of the Victorian division.

The official guest was Mr E. Nelson, Deputy Superintendent of Radio in Victoria.

Mr Nelson was introduced to the gathering by the Federal Vice-president Max Hull VK3ZS and, in response to a toast proposed by the Federal President Bill Mitchell VK3UM, Mr Nelson referred to the cooperation the department had received from amateurs during the recent disastrous bushfires.

The convention concluded on Easter Monday afternoon when all delegates expressed their thanks for the hospitality extended to them and the assurance given by the incoming executive that every effort would be made to implement the directions of Federal council with the minimum of delay.

Members attending the twenty-ninth Federal Convention in Melbourne were:—

Bill Mitchell, VK3UM, Federal President.
Max Hull, VK3ZS, Federal Vice-President.
Peter Williams, VK3IZ, Federal Secretary.
David Rankin, VK3QV, Federal Executive.
Harold Hepburn, VK3AFQ, Fed. Ex.
Kevin Connelly, VK3ARD, Fed. Ex.
Pierce Healy, VK2APQ, Fed Coun., N.S.W.
Michael Owen, VK3ZEO, Fed. Coun., Vic.
Laurie Blagbrough, VK4ZGL, Fed. Coun., Qld.
Geoff Taylor, VK5TY, Fed. Coun., S. Aust.
Roy Chamberlain, VK6RY, Fed. Coun. W. Aust.
Ted Cruise, VK7EJ, Fed. Coun., Tas.

Observers: Keith Howard VK2AKX, N.S.W.; John Battrick, VK3OR, Victoria; Ken Pincott, VK3AFJ, Victoria; Phill Williams, VK5NN, South Australia; Alyn Machetti, VK6ZDM, Western Australia.

Many matters were discussed and Federal Executive directed to implement the wishes of divisions, as expressed by Federal Council. The newly elected Federal Executive, under the leadership of Max Hull VK3ZS, is now fully aware of what is expected of it and have assured delegates that everything will be done to fulfil the tasks allotted them.

The retiring President Bill Mitchell, VK3UM, in his report, referred to an number of activities associated with the institute. Among these were:—The W.I.C.E.N. organisation of the Victorian division which gave sterling service during the recent bushfires in Gippsland; the steady increase in membership in all States; the study being made of the Federal Communications Commission Organisation in the United States of America and the valuable information received from John Huntoon, General Secretary of the American Radio Relay League.

The excellent progress of the Youth Radio Scheme was also mentioned as well as the work of the co-opted officers Messrs Kissick (Awards), Jones (Q.S.L. Bureau), Straughair (Certificates and Contests), Glover (Historical) and Black (Y.R.S.).

Details were given of the activities associated with the scout jamboree, new VHF and UHF records and various federal contests held during the year.

A review of the financial status of the Federal Executive indicated that the surplus shown for the year would be greatly reduced by the cost of producing new certificates for the John Moyle Memorial National Field Day and Short-Wave Listener Awards.

Thanks were extended to J. Lancaster for his services as Federal Secretary prior to his recent retirement due to ill health, and to Bob Boase, Federal Treasurer, for the excellent work they have done on behalf of the institute.

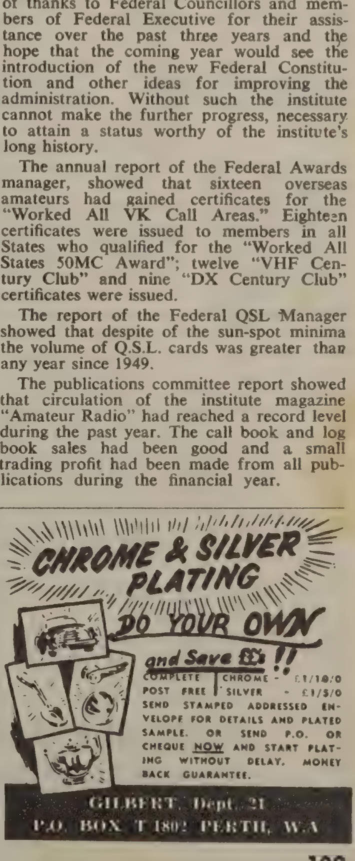
The report concluded with an expression of thanks to Federal Councillors and members of Federal Executive for their assistance over the past three years and the hope that the coming year would see the introduction of the new Federal Constitution and other ideas for improving the administration. Without such the institute cannot make the further progress, necessary to attain a status worthy of the institute's long history.

The annual report of the Federal Awards manager, showed that sixteen overseas amateurs had gained certificates for the "Worked All VK Call Areas." Eighteen certificates were issued to members in all States who qualified for the "Worked All States 50MC Award"; twelve "VHF Century Club" and nine "DX Century Club" certificates were issued.

The report of the Federal QSL Manager showed that despite of the sun-spot minima the volume of Q.S.L. cards was greater than any year since 1949.

The publications committee report showed that circulation of the institute magazine "Amateur Radio" had reached a record level during the past year. The call book and log book sales had been good and a small trading profit had been made from all publications during the financial year.

***News and notes of Divisional and Club activities, submitted for inclusion in these columns, should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W.**



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WIRELESS INSTITUTE ACTIVITIES

NEW SOUTH WALES DIVISION

The newly elected Council of the New South Wales Division met for the first time on Friday evening April 9th. The main business of the meeting was to elect the President and other officers for the ensuring year. Matters were not finalised, as it was necessary to confirm the willingness of some to accept the jobs allotted to them.

Those finalised were:—

President: Ivan Agar, VK2AIM.
Senior Vice-President: Bill Lewis, VK2YB.
Junior Vice-President: Jack Young, VK2OY.
Secretary-Treasurer: Mrs Betty Gerdes, Assoc.
Registrar and Minute Secretary: Warwick Johnston, Assoc.
Communications Officer: Dave Duff, VK2EO.
Education Officer: Harold Burtoft, VK2AAH.
Supervisor Y.R.S.: Rex Black, VK2YA.
Supervisor A.O.C.P. Classes: Cec Bardwell, VK2IR.
Bulletin Editors: Gerald Sabin VK2AGS; Warick Johnston, Assoc.
Q.S.L. Officers: Sid Molen VK2SG; Ted Whiting, VK2ACD.
Morse Training Supervisor: Frank Pearson VK2ACQ.
Disposals Committee: Ken Squires, VK2SD; Wal Kuhl, Assoc. Stephan Kuhl, VK2ZSK.
W.I.C.E.N. Supervisor: Vic Cole VK2VL.
Librarians: Mrs Hebe Grouse, VK2AOK; C. De Haan, VK2UE.

In a broadcast, following his election, from the Divisional Station VK2WI, the new President expressed these sentiments:—

"At this stage I would like to say how much I appreciate the confidence that Council has shown in me.

"It is indeed a great honour to follow in the foot-steps of Past-Presidents many of whom will long be remembered for their outstanding service to the Wireless Institute.

"Remembering this I feel very humble as I face the coming year, but, with the assistance of an excellent team of councillors and the support and co-operation of members of this Division, I confidently hope that this will be a year of progress and one of satisfaction to all concerned.

"I have no doubt that at times our actions will be questioned; that goes without saying in any organisation. In this regard I would ask that, instead of using 'rag chew' sessions on the bands to criticise council, you put your thoughts on paper and post them to the Wireless Institute Centre, where they will receive every consideration.

"It always seems a great pity to me that the Institute cannot utilise more of the talent that exists among our country members. Here there is some excellent council material that, for geographical reasons, must remain outside our governing body. To these people I repeat what I said a moment ago—put your views on paper and let us have them, so that both city and country can work together in our common interest.

"In conclusion may I express my thanks to the many people who have worked and are still working for the Institute.

"Let us show our appreciation to these willing workers by doing just a little ourselves during the coming year."

VHF AND TV GROUP

Members of the New South Wales Division VHF and TV Group held their Annual Meeting at the Wireless Institute Centre on Friday evening, April 2.

The Annual Report presented by the retiring Chairman, Mac VK2ZH, had a number of interesting observations on the activities during the year. Average attendance at the monthly meetings was 43 and the get-together over tea at the conclusion of the meeting at 10.30 p.m. had proved to be popular with members.

The VHF Newsletter had proved to be a successful medium for reporting all aspects of VHF activity. The call-sign VK2BWI, allotted to the group, is used as the official station in all group broadcasts.

All functions including participation in the National Field Day, A VHF Remembrance Day Contest, the Christmas Party and 144MC transmitter hunts had been well supported.

Many DX contacts had been made on 144MC during the year, including contacts to New Zealand and many over paths of 200 to 400 miles. Thanks was expressed to the committee and members generally for helping to make it a successful year.

The contest for the Chairman's Trophy was the closest for several years and not until the last contest was it certain who was going to be the winner.

The result was:

1st, David MacNaughton, VK2ZVW, 43 points; 2nd, Phil Irvine, VK2ZPI, 40 points.

The trophy this year was a suitably inscribed silver cup.

Silver cups were also presented to Paul Jackson VK2ZPJ and David MacNaughton VK2ZVW for their contact with each other from Point Lookout and Bald Mountain over a distance of 400 miles.

A lively and evenly contested ballot for six committee members resulted in the following call-signs heading the list. VK2ZPI; VK2ZPJ; VK2ZML; VK2ZVW; VK2ZTM and VK2ZSK.

The office-bearers elected are:

Chairman,	Paul Jackson	VK2ZPJ
Vice-Chairman	Tim Mills	VK2ZTM
Secretary	Mal Steward	VK2ZML
Committee members	Phil Irvine	VK2ZPI
	David MacNaughton	VK2ZVW
	Stephan Kuhl	VK2ZSK

Meetings are held on the first Friday in each month at Wireless Institute Centre 14 Atchison Street, Crow's Nest, at 8 p.m. Visitors are always welcome.

HUNTER BRANCH

The next meeting of the Hunter Branch will be held in Room 6, Clegg Building, Newcastle Technical College, Tighes Hill, on Friday, July 2, commencing at 8 p.m. Details of meetings of the Hunter branch are broadcast each Monday night at 7 p.m. on frequencies of 1815KC; 3595KC; 7050KC, with a relay on 144MC.

At this time of the year, the most reliable signal in the local area is that on 1815KC. This provides fade-free signals up to 100 miles from the transmitter and may often be heard much further away. Short-wave listeners are invited to send in reports on the Hunter branch broadcast. A QSL card will be sent to all those who report. The address for reports is Hunter Branch W.I.A., P.O. Box 1, Teralba, N.S.W.

One of the most successful contestants at the Easter Field Day and Convention held at Urunga was Les Baber VK2RJ. Les came first in the 7MC hidden transmitter hunt and second in the 144MC hidden transmitter hunt. Also, using for the first time his newly-built 7MC transmitter in the car, Les proved to be a worthy competitor for those using commercial equipment.

Several of the recently licensed amateurs in the branch area are now on the air both on the VHF and HF bands. Three other members, Mike Latham, Fred Overvliet and Henry Schroeder are still awaiting their call-signs. It is expected that all these VHF operators will be attempting the morse examination at an early date.

Activities at the Cessnock Radio Club, VK2AXC, are on the increase and on Tuesday nights morse, theory and practical classes are held. The club has a well-established HF station and aerial system in use. Intending members in the Cessnock area are advised to contact Chris Cowan, VK2PZ, Aberdare Road, Aberdare or telephone Cessnock 70.

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CENTRAL COAST SECTION

The Annual Meeting of the Central Coast Section of the New South Wales Division was held at the School of Arts, Gosford, on Friday evening, April 9.

The new executive elected for the ensuing year is as follows:—

President: Ern Hodgkins, VK2EH; First Vice-President: Alex Swinton, VK2AAK; Second Vice-President: Fred Adams, VK2ALA; Secretary: Geoff Mann, VK2XA; Treasurer: Perc Day, Assoc.; Publicity Officers: Frank Pearson, VK2ACQ; Mona Swinton, VK2AXS; G. Tibbett, VK2UX.

Among the activities of the Gosford Radio Club are organised inspections of various electronic and communication centres, the most recent being to the Overseas Tele-Communication Receiving Station at Bringelly, N.S.W.

Members also take an active part in local Civil Defence activities, Major Collett, VK2RU, being Signals Officer in the Gosford Shire, while Phil Levenspiel, VK2TX, has just returned from a Civil Defence Communication School at Mount Macedon in Victoria.

Visitors are always welcome to the meetings of the Club, on the second Friday in each month.

CANBERRA RADIO SOCIETY

With an outstanding program, including old and new contests, scientific visits of great interest and all the beauties of the National Capital and the Snowy Mountains available, the convention was a great success.

Commencing on Good Friday evening with seventy present, a series of films on satellites and deep space probes were shown, together with a display of SSB equipment by Arie VK2AVA and a talk on the Tinbinbilla Space Track Station by John, VK1QL.

On Saturday there was an inspection of the Tinbinbilla Space Tracking Station followed by a picnic lunch at the Cotter Dam Reserve.

Sixty-six attended the official dinner at the Canberra-Rex Hotel, where a very pleasant evening was spent. The Guest Speakers were Ivan Agar, VK2AIM, President, N.S.W. Division, Frank Pearson, VK2ACQ, and Geoff Thompson, VK3AC.

On Sunday a large group were shown around the Australian National University Nuclear Physics Department by Tony, VK1SG. This was followed by a number of mobile contests during the afternoon. The evening session saw a large variety of excellent prizes donated by Astor-Homecrafts, Aegis, William Willis, A.W.V., Belling-Lee, R. H. Cunningham, Warburton Franki, A and R Transformers and Ducon. Contest winners were:—

Receiving Contest: Geoff Thompson, VK3AC: 7 MC Hidden Transmitter: Rodger Davis, VK1RD; 144MC Fox Hunt, Phil Irvine, VK2ZPI; All-Band Scramble: Don Robinson, VK1DR; 144MC Hidden Transmitter: John Clode, VK2EZ; 7MC Fox Hunt: Bill Pascoe, VK1AWU.

The convention concluded on Monday morning with an inspection of the Belconnen Naval Transmitting Station.

VICTORIAN DIVISION

The Victorian Division, who were the host for the Federal Convention over Easter, received the praise of all delegates for the hospitality extended to them. As a break from the conference table for a few hours on Easter Sunday, a barbeque lunch and a couple of mobile events were organised at Ferny Creek.

Barbecue steaks, lunch and afternoon tea organised by Max Dalton, VK3DF, and the XYL's of members satisfied some healthy appetites, while two mobile events added zest to the competitive urge.

The first event was entitled a "Caper," which was the first contest tried for mobile equipped VHF, FM set operators. This consisted of a message giving details for cars to follow. The difficulty was that the message was divided between fifteen cars and each crew had to contact the others to gather all portions of the message and then piece it together to be able to complete the course set out.

The second event was an eighty-metre hidden transmitter hunt. Prizes for these events were donated by Ken Milburn, VK3CW.

VHF GROUP

At the April meeting of the Group sixty members were present to hear Geoff Hughes, VK3AUX, and Geoff Begg, VK3ZFX, describe and demonstrate amateur TV equipment they had themselves constructed.

Geoff VK3AUX unit was a home-built TV camera, while Geoff, VK3ZFX gave a demonstration of a closed circuit system using a flying spot scanner.

The meeting also discussed the rules for the Ross Hull Memorial Contest, including a letter on the subject from the New South Wales group.

It was also reported that a five hour opening took place on the 52 MC band during Easter Sunday, between Victoria and Queensland.

SOUTH AUSTRALIAN DIVISION.

Officers elected at the Annual General meeting for 1965-1966 were:—

President: M. R. Dow, VK5KF.
Vice-Presidents: T. Laidler, VK5TL; G. Taylor, VK5TY.
Secretary: J. Haseldine, VK5JC.
Treasurer: H. Roberts, VK5MY.
Past-President: P. Williams, VK5NN.
Federal Councillor: G. Taylor, VK5TY.
Minute Secretary: M. Burford, VK5ZQ.
Council members: L. Cotton, VK5LG; J. Godson, VK5LV.

TASMANIAN DIVISION.

Council members elected at the annual meeting held in April were:—

Tom Allan, VK7AL.
Geoff D'Emden, VK7ZAS.
Ian Nicholls, VK7ZZ.
Terry Connor, VK7CT.
Charlie Spiegal, VK7JD.
Ted Beard, VK7EB.
Ted Cruise, VK7EJ.

At the time of writing these notes, details of the officers to be filled by those elected had not been received.

YO DX CLUB

In order to strengthen the friendly relations between the Rumanian radio amateurs and those in the rest of the world, the Central Commission of the Radio Sport (C.C.S.R.) of Rumania sponsors the "YO DX Club."

Membership in the "YO DX Club" is granted only to Rumanian amateurs and short-wave listeners who are able to prove by their activity and high operating achievements such as at least 100 countries confirmed, 15 awards or certificates received, or to those entitled as "Master of Sport" or as first class in the sportive classification.

"YO DX AWARD"

The YO DX Club is awarding a beautiful certificate to all amateurs and short-wave listeners everywhere, who having conducted two-way communication or reception with a certain number of YO DX Club members after January 1, 1963, as follows: Rumanian amateurs, 10 QSOs; amateurs in the European countries (DXCC list), 5 QSOs; amateurs in the rest of the world, 2 QSOs.

Contacts may be made on one or more bands, and using any type of transmission i.e. A1, A3, SSB or mixed. The certificate is issued after sending an application and a checking log, showing the date, time, band, type of transmission and RST (RS) of the YO cards received by the applicant, to the following address: YO DX CLUB, P.O. BOX 95, BUCHAREST, RUMANIAN PEOPLE'S REPUBLIC.

The logs should be certified by the association or club, confirming that the applicant is the owner of the YO QSL cards; no cards are thus needed for direct checking.

The certificate is free of charge for amateurs of associations and clubs accepting this condition of reciprocity. The fee for all other amateurs is 5 IRCs. The YO DX Club will publish regularly a list of new members appointed.

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MSP 6 x 9 twin cone 15 ohm	£2 15 0
MSP 12 inch twin cone 15 ohm	£3 15 0
MSP 4 inch 3 ohm	£1 0 0
M.S.P. 7 x 5, 3, 15 ohm.	£1/15/-
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1200ft on 5in reel (Mylar Base)	35/
1800ft on 5in reel (Tensilised Mylar)	52/6
1200ft on 5¾in reel (Mylar Base)	35/
1800ft on 5¾in reel (Tensilised Mylar)	52/6
1200ft on 7in reel (Acetate Base)	22/6
1200ft on 7in reel (Mylar Base)	27/6
1800ft on 7in reel (Acetate Base)	35/
1800ft on 7in reel (Mylar Base)	39/6
2000ft on 7in reel (Mylar Base)	42/6
2400ft on 7in reel (Mylar Base)	52/6
3000 on 7in reel (Tensilised Mylar)	75/
3600ft on 7in reel (Tensilised Mylar)	92/6

EMPTY TAPE REELS

3in	2/6	5in	3/6
3¼in	3/3	5¾in	5/6
4in	3/6	7in	5/

OR in Plastic Storage Box

5in	8/	7in	12/

TAPE SPLICERS. Complete with Splicing Tape and instructions 5/
BIB TAPE SPLICERS 27/6

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PK-522 3 Transistor, Single Ended 50 mW Output	£2/17/6
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PK-801 4 Transistor, Push Pull, 1 Watt Output	£5/17/6
PK-633 3 Transistor, 1 Diode, Broadcast AM Tuner	£6/15/
"MITYAMP" 2 Watt Audio Amplifier, encased in Epoxyresin	£7/10/

"CABENA" LOW PASS FILTER Eliminates TVI and BCI

Cut off Frequency—30 Mcs.
Attenuation at 60 Mcs better than 30db.
Insertion loss negligible.
Impedance 50-75 ohms.
Maximum power input to filter at 72 ohms is 400 watts peak when the Tranmission Line is correctly matched.
This unit is connected as near to the transmitter as possible.
£5/12/6 inc. tax. (PL259 coaxial plugs to suit, **9/6**.

COAXIAL CABLES

UR67 50 ohm ⅜in diam. coaxial cable **1/6 yd.** or **25/** per 27yds roll.
UR43 50 ohm 3/16in diam. coaxial cable **15/** per 35ft roll.
UR71 72 ohm ¼in diam. coaxial cable **1/6** yd or **£1** per 25yds roll.

ALL ABOVE CABLES ARE IN AS NEW CONDITION.

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Imported Germanium Pocket Radios Complete with Earphone and instructions.
To Clear 19/6

SWR METERS Model KSW-10

SPECIFICATIONS:
Standing Wave Ratio: 1:1 to 1:10.
Accuracies: plus or minus 3% scale length.
Impedance: 52 ohms and 75 ohms.
Meter: 0-100 DC microamperes.

PRICE: £9/10/- inc. Tax

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10 waits (5 watts per Channel) .. **£19/17/6**
For details see March advert. RTV & H.

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"KEW" Model K-116 (PV202)

Complete with DC Probe and Leads, **£27/5/**, inc. Tax. RF and HV Probes Extra.

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Brand New, Bankrupt Stock, Well-known Make.

8in Twin Cone, 10 watt 15 ohm V.C.,	£3/19/6
5in Twin Cone, 4 watt Tweeter 15 ohm V.C.,	£2/5/
6in Speakers 3.5 or 15 ohm	42/
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COMMUNICATION RECEIVERS, TRANSMITTERS, TEST EQUIPMENT, AMPLIFIERS, TRANSISTOR RADIOS, TAPE RECORDERS, SPEAKERS, TRANSFORMERS, ETC.

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AMERICAN TYPE

PL259 Coaxial Plug	9/6
4087-1 Coaxial Plug (PL259 PTFE)	14/6
SO239 Coaxial Socket (Suit PL259)	9/
4802-1 Coaxial Socket (PTFE)	14/8
C32-14 Coaxial Dble. ended female Cable Joiner (PTFE)	17/6
UG175U Adaptor for PL259 to suit ¼in Cable,	2/9
C32-17 Coaxial "T" Piece suit PL1259	23/3
BNC Series	
UG 88 C/U Coaxial Plug (PTFE)	15/9
UG290/U Coaxial Socket (PTFE)	12/6
Belling Lee Type	
Coaxial Plug (Suit ¼in Cable)	4/
Coaxial Socket	3/6
Coaxial Socket (flush Mount)	3/6
Coaxial Cable Joiner (female)	4/

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Microphone Plugs, PMG Type Standard	4/
Socket to suit above	3/6
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4 pin small speaker plugs and sockets,	1/9 pr.
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Miniature Marker Crystals Complete with Socket.

3500 Kc	£2/10/
5500 Kc	£2/10/

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85 Kc IF Transformers	25/
455 Kc IF Transformers Med. Gain	25/

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4 Station, 1 Master, 3 Sub-Stations, 3 Transistor, 200 mW Output, Complete with 66yds wire, Battery, Staples, etc., **£10/5/**
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Twin Flat Speaker Lead **8d** yard, ideal for intercoms.

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Brand new, Sub-miniature & Pigtail, PVC sleeved

Mfd.	Volts	Price	Mfd.	Volts	Price
2	12	3/	30	6	3/
4	3	3/	30	12	3/3
5	6	3/	32	350	5/
5	12	3/	50	6	3/
5	18	3/6	50	12	3/6
8	10	3/	50	25	4/6
8	15	3/	64	6	3/3
8	300	4/9	64	18	3/3
8	600p	5/9	100	6	3/3
10	3	3/	100	12	3/8
10	6	3/	100	25	5/
10	12	3/	100	350	15/
10	25	3/3	250	3	5/
16	10	3/3	250	16	5/3
16	300	5/3	250	50	9/
16	600p	7/	500	12 D	5/
24	350	7/	500	50	13/
24	500	7/6	1000	6	8/3
25	3	3/	1000	12	9/9
25	6	3/3	1000	18	11/6
25	12	3/	1000	25	13/3
25	25	3/6	50+50	350	16/
25	50	4/3	(can type)		

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Well-known make "E" Type.

5000 ohm to 3.5 ohm	18/6
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7000 ohm to 3.5 CT	25/
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290v-0-290 volt 60mA, 6.3v 2A, 5v 2A,	27/6
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SAKURA TR6S Multimeter 20.000 opv D.C.,	£9/5/
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Multimeter Probes	6/
200H Movement	57/6
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MTC71/OC71 Transistors, **7/6 ea. or 3 for £1**
Sato Subminiature Bezels 6-8 volt No. 3280 complete with globe. Red or black. **4/**
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40, 60 1 lb packet	18/
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MR2P VU Meter,	45/
MO65 50 mV D.C.,	37/6
MR2P 50-0-50 uA,	55/
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MO52 2 ⅝in Round Face, 2in Hole, Black Plastic Case.

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"S" Meters read S1 to S9 plus 10 to 30 db. FSD 1 m/a.
MR2P 37/6

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MR3P	£4/2/6
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MR1P 1¼in Square Face, 1in Round Hole, Clear Plastic Case.
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MR2P 5Ma.DC	35/
MR2P 10Ma.DC	35/
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MR3P 10Ma.DC	47/6
MR3P 25Ma.DC	47/6
MR3P 50Ma.DC	47/6
MR3P 100Ma.DC	47/6
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MO65 100uA.DC	55/
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MO65 1Ma.DC	35/
MO65 5Ma.DC	35/
MO65 10Ma.DC	35/
MO65 20Ma.DC	35/
MO65 50Ma.DC	35/
MO65 100Ma.DC	35/
MO65 150Ma.DC	35/
MO65 250Ma.DC	35/
MO65 500Ma.DC	35/
MO65 15v DC	35/
MO65 30v DC	35/
MO65 300v DC	42/6
MO65 300v AC	42/6
MO65 1Amp.DC	35/
MO65 30-0-30 Amp. DC	42/6
M065 50 mV D.C.	37/6
M065 100 mV D.C.	37/6

MR52 2½in Square Face, 2in Round Hole, Black Plastic Case.

MR52 500uA.DC	47/6
MR52 1Ma.DC	£2
MR52 5Ma.DC	£2
MR52 10Ma.DC	£2
MR52 25Ma.DC	£2
MR52 50Ma.DC	£2
MR52 100Ma.DC	£2
MR52 250Ma.DC	£2
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LOG BOOKS, 5/6 each, postage 1/-.

CLIENTS PLEASE NOTE

ALL PRICES QUOTED IN THIS ADVERTISEMENT INCLUDE SALES TAX WHERE APPLICABLE. PLEASE ADD POSTAGE WHEN ORDERING. SORRY, NO C.O.D.

W.I.A. YOUTH RADIO SCHEME

One of the main items discussed at the Wireless Institute of Australia Federal Convention held in Melbourne over Easter was the progress already made and plans for expanding the scope of the Youth Radio Scheme.

A comprehensive report on the activities during the past year, prepared by the Federal Co-ordinator, Rex Black VK2YA, contained these points:—

"The operations of the Youth Radio Scheme during the 1964-1965 period has, in the eastern States, been a period of real progress and major effort by all concerned. In other States progress has been somewhat slower.

"During the year a great amount of correspondence has been exchanged with the various divisional supervisors of the Y.R.S., with outside organisations within Australia and, notably, with the Radio Society of Great Britain, which has been investigating the possibility of starting its own Youth Radio Scheme.

"Constant negotiations have been conducted with other Australian youth organisations. The secretary of the Duke of Edinburgh's Award Committee asked for advice on the radio aspects of this new youth scheme. The handbook was drawn up to suit English conditions and the committee felt that an Australian handbook should be prepared to meet local conditions. Accordingly a detailed scheme was submitted, based on our certificate syllabi and this is now under consideration by the Duke of Edinburgh's Award Committee.

"The proposals envisage three sets of conditions to meet the bronze, silver and gold awards "Projects" requirement. It is anticipated that some finality will be reached on these negotiations before long. I propose that the next revision of our syllabi will include the relationships which exist between the Duke of Edinburgh's award and our certificates. The fact that this important committee has seen fit to seek advice from our Youth Radio Scheme indicates that our efforts have met with acceptance and recognition in circles beyond the limits of the W.I.A.

YOUTH MOVEMENTS

"The Boy Scout Movement is currently revising its proficiency badge requirements and the various suggestions which have been forwarded to their National Headquarters are still under consideration. Mr Ken Matchett, VK3TL, has been associated with these deliberations and it is hoped that ultimately some final decisions will be reached and mutual recognition of awards will be authorised by the Scout movement.

"The Boys' Brigade, a Church organisation of wide distribution, has examined various uggestions which have been submitted for consideration at its recent Federal Convention in Adelaide. It is anticipated that, s result, there will be close liaison between he Y.R.S. and the brigade and the latter body will introduce additional proficiency wards — badges and certificates — to reognise radio training.

"The Australian Air League is another Australian youth organisation which is inerested in our work and several discussions ave taken place which show considerable romise for future co-operation. Most of hese negotiations are approaching finality nd next year's report should indicate the ature and extent of the co-operation which as been achieved. Of course, there are ther youth movements which still have to e contacted and time is the only factor hich has prevented this. However, these scussions indicate clearly that there is a al need for the type of activity which the outh Radio Scheme offers to young Ausalians.

"A pleasing feature of this year's operaons has been in the number of Youth Radio Scheme members who have gained Amateur Operators' Certificates of Proficiency (Full and Limited) while they were still at school. Most of these were gained by boys in fifth and fourth forms, but Garry Tippett, of St. Edward's College at Gosford, was the first third-form student to gain this distinction. In addition, a number of associate members from school clubs has increased the membership of the Wireless Institute. However, I still feel that our scheme can never realise its maximum benefit until a system of novice licensing is introduced, whereby science teachers, manual arts teachers and leaders of non-school clubs can gain limited transmitting privileges with less time and effort than the present system entails.

"It is noteworthy that increasing numbers of science teachers are forming radio clubs in secondary schools. In the early days of the scheme hardly any club leaders were members of science staffs. The picture is changing radically and practically all new clubs are being organised by science teachers. Much of this is due to Mr Henderson, head lecturer in physics at Sydney Teachers' College, who urges all his final-year students to participate in our scheme.

"Recently Mr Henderson organised the Sydney Teacher's College Radio Club, comprising 25 final year science teacher-trainees who will be posted to State High schools at the beginning of 1966, well versed in matters associated with radio club activity and fully aware of our Y.R.S. methods, courses, examinations and certificates. The N.S.W. Divisional Council is well aware of the strategic value of Mr Henderson's efforts in this matter, and has made available a FREE A.O.C.P. Correspondence Course to a student nominated by Mr Henderson.

"A further interesting development lies in the approval which the N.S.W. Education Department has given to Mr R. Pearson, Manual Arts Master at Arthur Phillip High, Parramatta, to conduct a radio craft course for second form boys, following our Y.R.S. syllabus.

"Another pleasing feature of this year's progress is seen in the increasing number of ex-Radio Club boys entering the elctronics industry as apprentices, trainees and cadets. Others have proceeded to Science courses at universitites. Former Y.R.S. members are now found in the armed services as radio apprentices, in D.C.A. and P.M.G. training schools and in private electronic firms as apprentices and cadets.

"In the N.S.W. Division a large range of inter-club competitions has been presented for the 1965 session. Prizes of money and radio components have been specified, and it is hoped that these incentivies will encourage members to participate and club leaders to urge their charges to attempt these contests. It is also suggested that thought be given to the desirability of having lapel badges available to club members."

VICTORIA

The first meeting of supervisors of the youth radio scheme in Victoria was held in the division's rooms, 478 Victoria Parade, East Melbourne, on April 23, 1965. Those attending were: Ken Matchett, Victorian division supervisor; E. D. Buck and Ron Everett, Australian Postal Institute P.M.G. Training School, Tooronga; H. Major, Collingwood Technical School, Collingwood; P. Boa, Greythorn High School, North Balwyn; Bruce Whitehead and Cyril Minns, Royal Victorian Institute for the Blind, Burwood; Ron Slater, Howard Wills, J. Evans and B. Fisher, McLeod Radio Club, McLeod; Rev. Bro. G. M. O'Brien and P. A. Lavery, Edmond Rice College Club, Bundoora; D. Godfrey, Yallourn Technical College, Newborough; R. Tucker and P. Garde, Scotch College, Hawthorn; W. Allen and M. Brane, Gowrie Park State School, Glenroy; M. Plummer, Essendon Grammar School, Essendon; A. McPhee Swinburne Technical College, Hawthorn.

Also present was John Batrick, VK3OR, president of the Victorian division, who answered questions and explained how assistance could and would be given the clubs that affiliated with the division. Pierce Healy, VK2APQ, N.S.W., Federal councillor, gave some details on the operation of the scheme in New South Wales and the main points in the report of the Federal Co-ordinator, Rex Black, VK2YA, which was presented at the Federal Convention.

The main points discussed by the supervisors were: textbooks and syllabi and the various methods of demonstrating the fundamental principles of components and circuitry. The methods of financing and procurement of equipment suitable for the various constructional projects were discussed at length and the thanks of the organisers was expressed to: A.W.V., Anodeon and Ducon for components and literature, to "Electronics Australia" for publications, Keith Howard for descriptive circuits and the Victorian division for the assistance in many ways.

It was also agreed that liaison between clubs would help to stimulate interest in interclub competitions and foster the friendships which are so much a part of amateur radio. Some thought was given to setting up a committee to handle the various tasks such as general secretarial work, the monthly newsletter and the issue of certificates to successful students.

In summing up the evening's discussion, all agreed that the meeting was well worth while, both from the social aspect and as a means to discuss problems and exchange ideas.

It was agreed that another meeting should be held in two to three months' time when it may be possible for organisers from country centres to attend.

WESTLAKES RADIO CLUB

The Westlakes Radio Club will be holding its first Field Day during the Queen's Birthday weekend. On Sunday, June 13, the clubrooms in Railway Street, Teralba, will be open to visitors and there will be several hidden transmitter hunts during the day. Intending hunters are advised to bring a suitable direction-finding receiver (a shortwave transistor portable is ideal) because most of the hunts will be on foot.

However, there will be one 40-metre transmitter hunt for those with cars and there will be several two-metre "Sniffers" at the club for those who do not have equipment of their own.

A charge of 5/ will be made for entrants but this will cover all hunts. Hot food will be available on the site and there is ample parking space for cars.

For those travelling by rail, the Teralba station is only 50 yards from the club.

The new series of broadcasts "Electronics by Radio," entitled, Electrons in Motion, will be broadcast on the June 14, 21, and 28 and July 5. These transmissions will be made on 1815KC, 3595KC and 7050KC.

Full details and free lesson notes may be had by writing to "Electronics by Radio," P.O. Box 1, Teralba, N.S.W.

TRANSISTOR SERVICE

ALL JAPANESE MAKES
REPAIRED
including . . .

Aristone Berlin General Mariner National
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We do not sell spare parts
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SPECIAL PURCHASE OF FACTORY STOCK

RESISTORS, CONDENSERS AND POTENTIOMETERS

We have purchased the resistor and condenser stock of manufacturers including S.T.C. and Stromberg-Carlson who have ceased the manufacture of television and radio receivers and can offer same at less than 25 per cent of list price.

The resistors are mainly I.R.C. and Morganite in values from 200 ohm. to 5 meg in ½, 1 and 2 watt ratings and include some wire wound resistors. List price, £4/10/- per 100. **Our Price, 20/- per 100.** Post and packing, 2/6 extra.

The condensers are in most popular makes and include mica, ceramic, paper and electrolytic in standard values. List price, £5/10/- per 100. **Our Price, 20/- per 100.** Post and packing, 3/6 extra.

The potentiometers are all current types and include switch pots. and dual concentric. List price, £6 per dozen. **Our Price, 25/- per dozen.** Post and packing, 2/6 extra.

FREE For a limited period with each lot of resistors, condensers or potentiometers purchased we will supply free: One New Valve Type 6U7G or 1T4 or One New English Miniature 11 x 1 Switch as advertised on this page.

New English Miniature 11 x 1 Switches

These new miniature eleven-position single-bank switches are 1" diam. with ¼" spindle, they have silver-plated contacts and high quality insulation suitable for H.F. use.

4/9 each. Post and packing 1/6.

NEW GARRARD RECORD CHANGERS

These New English Garrard Changers with High Fidelity Crystal Pick-ups and Sapphire Styli have just been superseded. We are selling same at LESS THAN HALF PRICE. Available in STEREO at £12/15/. POST AND PACKING EXTRA: N.S.W., 15/-; QLD., VIC., TAS., 22/6; W.A., S.A., 30/-.

HIGH-SPEED 240V. AC/DC MOTORS

These 240 v. a.c. or d.c. motors are 1/8 H.P. with a speed of 7,000 R.P.M. and are ideal for small drills, grinders, etc. Dimensions, 5½in x 3½in, with 5/16in spindle 37/6

Post, N.S.W. 5/-; Post, Interstate, 8/6.

NEW 4-SPEED STEREO PLAYER F.O.R. £8/15/0

NEW STEREO CHANGER, 4-SPEED F.O.R. £10/15/0

SLIDER-SWITCHES

10 pole 2-way silver plated contacts 3/9

TYGAN AND SARLON SPEAKER GRILLE FABRIC

54in wide. List price 60/- per yard. To clear at 40/- per yard.

Postage and packing N.S.W., 3/6; Interstate, 4/6.

LEADER SIGNAL GENERATOR LSG11

240V A.C. operated, 6 band 120KC to 390 Megs. Provision for crystal.

Post N.S.W. 7/6; Interstate 12/6. £15/-/-

BATTERY CHARGER RECTIFIERS

New Selenium Rectifiers, 6 or 12 volt, at 4 amp., 37/6. Post, N.S.W., 2/; Interstate, 2/. Transformer for above rectifier tapped for 6 or 12 volt, with circuit for charger, 47/6. Post, N.S.W., 7/6; Interstate, 10/.

As above, 6 or 12 v., at 2 amp, 27/6. Post: N.S.W., 3/6; Interstate, 4/6. Transformer for above, 37/6. Post: N.S.W., 3/6; Interstate, 4/6.

NEW 240V. A.C. MOTORS

These small motors, size 3in x 3in x 3½in, are 1-12 h.p. but are only suitable for intermittent use. 29/6. Post N.S.W. 3/6. Int. 5/.

NEW A.W.A. OAK SYNCHRONOUS VIBRATORS, 7-pin, 6v. 7/6. Post and Packing 2/.

NEW GARRARD TAPE DECKS
AT LESS THAN HALF PRICE

SINGLE SPEED 3¾in takes 4in spools. Two motors, simplified controls, supplied with tape £9/19/6: Post and packing N.S.W. 12/6. Interstate 20/.

OSC. COILS 15/-

NEW B.S.R. TAPE DECKS

These new 3-speed B.S.R. Decks are fitted with a digital counter and will take 7" spools.

2 Track £17/15/, 4 Track £22/12/6.

NEW 4" EXTENSION SPEAKERS

These 4" speakers are mounted in polished cabinets suitable for use as intercom. units or extension speakers.

LIST PRICE .. .. £6.

SPECIAL PURCHASE ENABLES US TO SELL THESE UNITS AT 40/. Post and packing, N.S.W., 6/9. Interstate, 9/9.

NEW ELECTROLYTIC CONDENSERS
AT LESS THAN HALF PRICE

70 mfd + 30 mfd 400v	9	6	70 mfd + 25 + 5 + 5 400v W	12	6
100 mfd + 200 mfd 350v.	12	6	8 mfd 400v pig tail	4	6
50 mfd 12v	2	0	16 mfd 400v	5	6
64 mfd 350v	7	6	25 mfd 25v	2	9
16 mfd + 8 mfd 300v W	7	6	100 mfd 350v pig tail	9	6

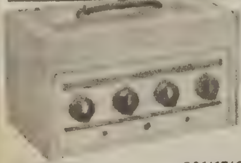
POST EXTRA

NEW AMERICAN TWIN TELESCOPE TV AERIALS

Extends to 36in each section can be used singly for car or portable radio. 20/

POST 2/-.

NEW 17 & 25 WATT P.A. AMPLIFIERS



25 WATT £26/17/6
17 WATT £21/17/6

Post Extra on 15 Watt N.S.W. 10/ Interstate 15/. 25 Watt by Rail or Air. Too Heavy for Post.

The 25 Watt Amplifier uses 5 valves plus 2 rectifiers including two EF86 low noise valves as microphone preamplifier and two EL34 valves in push-pull output.

All amplifiers are fitted with A. and R. output transformers with voice coil tappings of 2 to 15 ohms. **The 25 watt amplifier can be supplied with line output transformer tapped from 100 to 600 ohms if required at 20/- extra.**

Inputs provided for microphone, pick-up, and radio with mixing facilities and tone control.

The 15 watt is as above but using two 6BQ5 valves in push-pull output.

12in speaker for above (10 watt) 67/6

Crystal Microphones for amplifier 47/6

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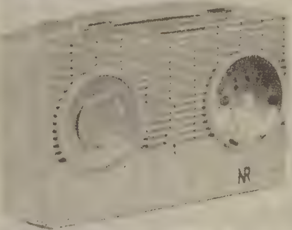
332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398.

Special Purchase of Manufacturer's stock of Transistors and Transistor Components enables us to offer Transistors and Kit-sets at a fraction of original cost.

Complete KIT for TRANSISTOR 6 PORTABLE £10/19/6



The complete kit of parts for the transistor six includes six transistors, printed circuit board, coil kit, 4in speaker, Ferguson driver and output transformers, heavy duty battery and all necessary parts to complete the set with full instructions. **Set is housed in attractive plastic case as illustrated.**

Set can be supplied wired and tested at £2 extra.

Dials available for all States. Post and Packing extra N.S.W., 10/; Interstate, 13/.

NEW ENGLISH MAZDA TRANSISTORS

TYPE	EQUIVALENT		
XA101	OC45	R.F. Transistor	5/6 ea.
XA102	OC44	Osc. Transistor	7/6 ea.
XB103	OC75	Audio general purpose	7/6 ea.
MTC71	OC71	General Purpose	

Ducon type SFT 123 equiv. OC74 .. .. 7/6 ea.
Available in matched pairs at .. .. 15/ pair
AUDIO OUTPUT
Post and packing on transistors 1/6 any quantity.

A.W.A. 23" E.H.T. transformers and 23" 110 deg. deflection yokes. New manufacturers stock E.H.T. units 50/-. Deflection yokes 50/-. Post free

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866	15/
6X5GT	7/6
5Y3GT	9/9
5Z4G	12/6
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1T4	4/6
3S4	10/
1A7GT	9/6
1D8GT	9/6
6K8G	6/9
6SJ7GT	9/6
12K8	10/
EK32	6/9
6SA7GT	9/6
6SH7	5/6
1Q5G	2/6
1P5G	2/6
1C7G	3/
1K5G	4/
1M5G	4/
1K7G	4/
6C8G	5/
6SS7	8/6
6H6GT	2/6
6K7GT	7/9
6U7G	5/
7C7	3/6
12AU7	11/6
12AT7	10/
6SN7	9/6
6F6	10/
12SK7	5/
6B8	10/6
VR65A	2/6
7193	2/
12A6	8/
12SH7	5/
6K7G	4/6
955	2/6
954	2/6

Please add postage on all valves.

NEW 4-SPEED STEREO & MONO PLAYERS
AT LESS THAN HALF PRICE

PHILIPS 4-SPEED
6V BATTERY PLAYER

MONO	£4/17/6
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3300 R.P.M. can be supplied with or without 4-speed reduction mechanism. Size 3¼" x 2¾ x 3½, including spindle.

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5-Transistor amplifier. 2 watt output, 6 or 12 volt input, 3 to 35 ohm output. Suitable for record players, inter-com, or any application where a small amplifier is required. Circuit supplied. **£7/15/-**

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60mA prim.: 240v with 230v tapping Sec. 285 x 285 with 6.3v filament winding 60mA., 25/-. Plus postage: N.S.W., 3/6; Interstate, 5/3.

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SHOP SOILED 80 M.A. TRANSFORMER

285 x 285

Two 6.3 volt windings **15/-** each plus post. N.S.W. 6/-, Interstate 10/-.

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10½in spool 3650ft Mylar	£4/15/0

Post and packing, 2/6 extra.

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40mA prim., 250v. Sec. 225 x 225 with 6.3v Fil. Winding.

27/6 **Postage: N.S.W., 2/6; Interstate, 4/6.**

30mA 240v Prim. 150 x 150v. Sec. with 6.3v. Fil. Winding.

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TRANSISTORISED SIGNAL INJECTOR, 55/-

A MUST FOR QUICK TROUBLE SHOOTING

Using TWO Transistors, complete with instruction sheet and battery. Post free

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6in Per Mag	35/
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6in x 9in Per Mag Hvy. dty. 15 ohm	42/6
8in per Mag	37/6
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Post and Pack. 5/- N.S.W., 7/6 Interstate

12in Per Mag .... 67/6, Post and Packing 7/6 N.S.W., 10/- Interstate.

Speaker Transformers for above 6T, 5T or 7T 10/-

NATIONAL RADIO SUPPLIES

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CONVENIENCE AND SERVICING SPEED IN ONE COMPACT CASE

For the busy technician who is interested in convenience and servicing speed, the Model 960 transistor Radio Analyst facilitates the analysis and trouble-shooting of transistor portable radios. On the service bench, it provides in one compact case the signal-generating and measurement devices needed to diagnose and isolate troubles in a transistor radio.

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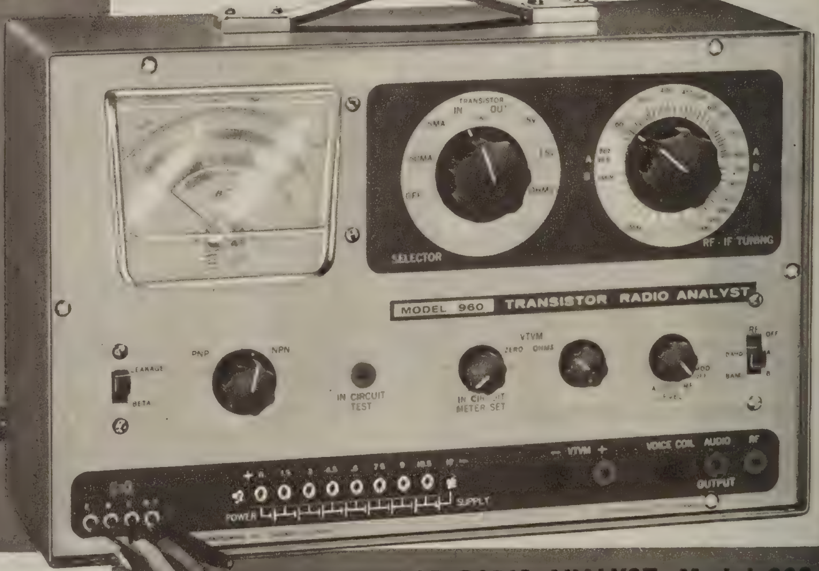

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- Out-of-Circuit Transistor Test — tests NPN or PNP transistors; reads leakage on good-bad scale; reads beta on 0 to 150 scale or good-bad scale; tests both triode and tetrode transistors, special test indicates shorted or open power transistors.

PRICE £66/10/- PLUS TAX

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LISTENING AROUND THE WORLD

Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.

BBC Relay from Ascension Island

Information on the new BBC relay station on tiny Ascension Island in the South Atlantic was recently released, the station being due to come into operation next year.

FULLER details on the BBC relay station for Ascension Island in the South Atlantic were recently announced by Marconi, who have the contract for four 250KW transmitters for the relay station. The project will cost over £1½ million. The aerial system, costing £90,000 includes one 250ft and eight 325ft masts, with the usual high-angle aerial arrays.

The BBC plans were first announced in January, 1962. It was felt that the BBC signals did not get into South America and Africa as well as desired, but this station should correct the position. Relays for United States and German transmitters are now functioning while, last month, we gave some information on a new BBC relay in West Africa. The location is now known to be Liberia.

Recent checks in South America have verified that both Radio Moscow and Radio Peking are putting in stronger signals than received from the BBC transmitters sited n the U.K. Moscow signals are 8-14dB stronger than the BBC and Peking some 10-15dB louder again than Moscow. The use of higher power, high altitude to provide ow-angle radiation and possibly back scatter techniques could account for hese figures.

The recent cpening of the Bonaire station n the Netherlands Antillies is another case n which the operation of a relay station nearer the audience, has proved to be a uccess.

BBC PERIM RELAY

Return of the BBC relay station on 01KC on the broadcast band has been noted recently. As this was the frequency sed by the BBC relay station in the omali Republic, it was presumed this was he station again active on the channel, aving been off the air for some months, ue to political differences between Britain nd the Somali Republic.

However, information from the BBC n London gives the site of this relay ation on 701KC as the island of Perim, n south-west Arabia, at the entrance to he Red Sea. This tiny crescent-shaped land is strategically placed one and a alf miles off the Arabian coast, in the trait of Bab el Mandeb. The is'and commands the entrance to the Red Sea and is British colony. It is a cable station with a opulation of 1700 and has an area of square miles. The BBC relay on the island as been heard on 701KC at dawn at ood level.

ADIO AMATEUR NOTEBOOK ENDS

The popular Voice of America program adio Amateur Notebook" was withdrawn om the VOA program schedule at the d of April, after having been on the for 15 years, under its compere and oducer Bill Leonard W2SKE. As well as oviding news for the radio amateur, much the information was of value to the ort-wave listener, as it covered ch subjects as sunspot activity and predicns, new receivers and other electronic oducts new to the American market and news on reception conditions on a world wide basis.

In the last broadcast Bill Leonard said he hoped the closure would be temporary only and that the program could return to the Voice of America schedule in a new style in the future. It will be regretted by many readers that this special session has come to an end.

BUCHAREST SCHEDULE

The present schedule of Radio Bucharest in Roumania includes the use of the relatively new channel of 6150KC in its service to North America in English from 0300 to 0330. In all, the transmissions are now carried on 11910, 11810, 9590, 9570, 6190 and 6150KC.

The transmissions to North America are also carried on these frequencies in the broadcasts at 0130-0230, 0300-0330 and 0430-0500 all in English. They give good reception in the South Pacific area during our winter months.

FEBC USING 15230KC

A new 19M band frequency of 15230KC has been observed at 1200 hours GMT when the station of the Far East Broadcasting Company in Manila relays the Fine Music Station, DZFE on 1030KC broadcast band. This relay of the program on shortwave is confined to this one new channel of 15230KC to 1230 GMT, at which time another frequency, 9505KC also takes up the relay. Programs are of the Gospel and good music type, and news in English is broadcast at 1245. The signal is good, and free from interference, except from slight sideband interference from Berlin on 15240KC, which should be no trouble during our winter months.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are in GMT, add 8 hours for Perth, 10 hours for Sydney, and 12 hours for Wellington time. All frequencies are in kilocycles.

ULAN BATOR USES ENGLISH

For the first time in our knowledge the Ulan Bator Radio in the Mongolian Republic has been heard with an English transmission. First reader to report reception was Rex Gillett of Adelaide. The station is using two frequencies, 11850 and 9540KC, and the transmission is on the air four times a week for one hour duration. The English transmissions from Ulan Bator are broadcast from 2130 to 2230 Monday, Tuesday, Thursday and Friday.

The full text of the station announcement is: "You are tuned to Ulan Bator of the Mongolian Peoples Republic. Dear Friends, this is our regular broadcast in English for the countries of the Far East. You can hear our program four times a week, every Tuesday, Wednesday, Friday and Saturday from 0530 to 0630 Ulan Bator time, in the morning, at 25.3 and 31.5 metres or 11.85 and 9.54 megacycles."

The station is heard at good strength on 11850KC but the other frequency, 9540KC, is spoiled by interference. The station closes at 2230 GMT with an anthem.

RADIO CANADA SCHEDULE

Some major changes have taken place in the transmissions of Radio Canada from Montreal. In the service to Australia and New Zealand the former transmission 0715-0800 and 0800-0845, which was a repeat of the first transmission, has been replaced by an hour-long transmission. The new schedule, which will remain in effect throughout the winter months, is as follows:—

Australasian Service.	
5970, 9625KC	0725-0835GMT
European Service No. 1.	
17820, 15320, 5970	1055-1214
Europe-North America.	
17820, 15320, 5970	1215-1344
Europe.	
17820, 15320, 11720	1245-1830
Africa.	
17820, 15320, 11720	1832-1958
Europe.	
15320, 11720, 9630	2000-2152
Northern Canada.	
15320, 11720, 9625	2158-2246
Caribbean and Latin America.	
15190, 11760, 9625	2258-0045
Northern Canada.	
15320, 11720, 9625	0058-0705

RADIO PORTUGAL

Some clarification on the broadcasts of Radio Portugal was recently given by the station as follows:

The "Voice of the West" is not the name of an organisation, but only the title used for certain special programs.

The address of the Portuguese International Service is: Portuguese National Radio, Rua Sao Marcal 1A, Lisbon, Portugal.

The International Service issues its own verification card, and a report must contain the following details: Date, frequency of reception, and at least five minutes of program detail, including announcements and items heard; the use of the SINPO or SINFO code is desired. Some comparison of signals of stations on adjacent channels is also of value, as well as information on the receiver and antenna used by the listener. The SINPO code rates the signals from 0 to 5 in Signal strength, Interference, Noise, Propagation and Overall Merit, while in the SINFO code the Propagation section is replaced by details on Fading.

The Radio Portugal DX Club has the same membership requirements as Radio Canada. One has to submit five reception reports, and then at least one report each two weeks to become a member in good standing. Radio Portugal is best received from 0200-0245 and 0345-0430GMT on 6185 and 6025KC. The DX club is on the second and fourth Monday of the month.

SUNSPOT CONDITIONS

During 1965 the present sunspot cycle reaches its "low" and a new 11-year cycle commences. George Jacobs, of the Voice of America, recently reviewed the sunspot situation which largely governs the shortwave listening hobby and the usefulness of the various bands.

The sunspot numbers will rise from now on, with a gradual improvement in high frequency reception, particularly on the 16 and 13-metre bands.

When a sunspot cycle ends the last remaining sunspots are near the equator of the sun; when a new cycle begins, new spots appear on the face of the sun at a much higher latitude. New spots have been observed since August last year. When the number of old spots and the number of

SOUND PROJECTORS

Cinevox Prefect or Victor Pyrox 16mm in good working order. 240v operated, complete with speaker and amplifier.

£47/10/-

CIRCULAR SLIDE RULE

3¼in diameter. Will do the same work as the conventional slide rule. Instruction book included.

12/6 each. Post 1/-

REFLECTOR GUNSIGHT

Contains these lenses:
1 Lens 1in Focus. 1½in diam.
1 Lens 1 11/16in Focus, 1¼in diameter.
1 Air-spaced Lens, 1¼in diam.
1 Filter Lens. 1 Graticule.
1 Lampholder.

18/6 each

Post.: N.S.W., 3/-; Interstate. 4/-.

PMG TYPE TELEPHONES

Standard desk type with magneto calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line. Complete with ½-mile wire.

£11/10/- pair
(2 TELEPHONE SETS)

3/- cartage to rail. Freight payable at nearest attended railway station.

A.W.A. MOBILE 2-WAY RADIO

Car phone 70-85 mcs. 12 volt, with leads connector and control unit, £22/10/.

AERIAL CAMERAS

F.24 Mark IV 2.9. Lens. stops 11, 8, 5.6, 4, 2.9.
With 3" x 8" F1. Lenses complete with wooden case.

£19/10/-

5/ Cartage to Rail. Freight payable at nearest attended railway station.

TRANSFORMERS

240 Volt to 6 or 12 Volts 8 amps. £4/15/. 5 amps. 49/6. 2½ amps. 37/6. Post N.S.W. 7/. Interstate 9/6.

12 CREED TELEPRINTER

Tape printers model 47.R 240 Volts operated.

£17/10/0

2-WAY RADIO

Number 22 (Aust.) can easily be converted to Number 122 set, which is ideal for ship to ship and ship to shore radio service. Complete with power supply. Leads, Phones and Mikes., etc., less crystal.

£27/10/0

5/- Cartage to paid freight. Payable to nearest attended railway station.

INTERCOM SETS

2 Transistor two station.

£7/15/0

Post N.S.W. 4/6; Interstate 6/.
3 Transistor three station.

£13/10/0

Post N.S.W. 7/-. Interstate: 10/-

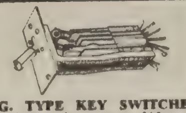
455 Kc NATIONAL IF FILTER CRYSTALS

65/- Postage 3/6

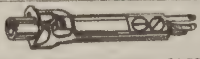
HIGH IMPEDANCE HEADPHONES

2,000 ohms.

29/6 per pair
Postage 1/2.



P.M.G. TYPE KEY SWITCHES.
Up to 8 sets changeover, 4/6 each.



P.M.G. TYPE PHONE JACKS, 2/ each.

NIFE CELLS

1.2 Volt fully charged, 4in x 3in x 1in 4 AH.

10/- each

Post N.S.W., 2/6; Interstate 3/6.
2.4v 6in x 2in x 2¼ 10 A.H. 25/.
1.2v 8 x 4 x 2in 25 A.H. 39/6.
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Battery Chargers

240 to 6 or 12 Volts at 2.5 amps. Will charge either 6 volt or 12 volt batteries. £4/19/6. With built in Amp Meter.

£5/19/6

Postage, N.S.W., 5/; I'state, 6/.

VALVES BRAND NEW

IN CARTONS

Special discount for quantity

6SN7GT	9/6	6AL5	10/
89	10/	6AK5	17/6
6Q7	7/6	6Y6	10/
12SA7	12/6	6X4	10/
6H6	4/6	6C8	7/6
80	12/6	6F8	7/6
41	12/6	6N7	10/
5U4G	9/6	6R7	5/
77	10/	6L7	5/
VR150-30	10/	7L7	5/
5CP1	39/6	5678	2/6
EF50	3/6	12SK7	5/
6U7	7/6	VR1120	5/
VI103	10/	VR118	7/6
VH120	7/6	VR65	2/6
1L4	10/	6R7GT	5/
717A	7/6	VT4C	7/6
K4C	10/	AU5	10/
10	10/	VU120	10/
5Y3	12/6	VR116	10/
6C4	5/	957	5/
6AG5	5/		

3" CV2184 . .. . 22/6

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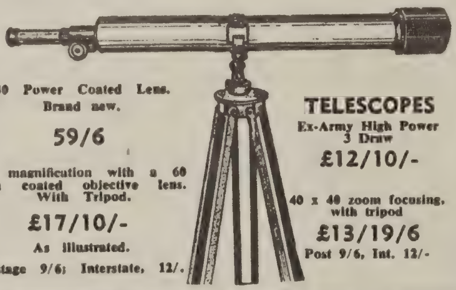

30 Power Coated Lens. Brand new.

59/6

60 magnification with a 60 mm coated objective lens. With Tripod.

£17/10/-

As illustrated.

Postage 9/6; Interstate, 12/.

TELESCOPES

Ex-Army High Power 3 Draw

£12/10/-

40 x 40 zoom focusing, with tripod

£13/19/6

Post 9/6, Int. 12/-

HIGH STABILITY RESISTORS

I.R.C. brand new ½w, 1w, 2w, tolerances between 1 and not exceeding 5% including 100, 360, 560, 750, 15K, 22K, 27K, 100K, 180K, 220K, 560K, 820K, ohms. Usual price 4/- each, 50 assorted different values for only

37/6. Post 1/6

ASTRONOMICAL TELESCOPES

3¼in, Reflector, 126 magnification. Complete with 4x finder and equatorial mount.

£29/10/-

Post: N.S.W. 7/, interstate 12/.

THEODOLITE

Cooke Troughton and Simms, London. Microptic. Tested. Complete with Tripod, £137/10/.

3000 TYPE RELAYS

P.M.G. 200 Ohm — 1,500 Ohm Coils. 12/6 each.

TELEPHONES

Sound Powered. Can be used as Microphone and Receiver. New. With 50ft cable.

38/6 pair

Post.: 2/6; Interstate, 4/.

S.T.C. DYNAMIC MICROPHONE

Low Resistance — Type 4017
Ideal studio, P.A., etc.,

£10 each

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H.T. TRANSFORMERS

2,000/0/2,000 volt. Primary 28 volt 50 cycs, rated at 1.75 Kva., ideal lenniar amplifier, etc.

£13/10/-

TAPE RECORDERS

Elcon studio quality with level meter and mike save £100.

2 track 3¾ and 7½ IPS

Price £37/10/0

CHOKES, 7.5H, 60mA	9/6
5H 1.5A	30/-
VIBRATORS, 6 and 12v, 7 and 8-pin	7/6 each
UNISELECTORS, 4 BANK HOMING TYPE	30/-
INVERTERS 27v-80v 2KW 2000 cycles	£4/15/-
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HAND MICROPHONES, with Press-to-Talk Switch.	9/6 ea.
Post. N.S.W. 2/6, Interstate 3/-.	
INSTRUMENT TRIPODS, sturdy wooden frame. Telescopic. Extends to 4ft 6in.	£6/10/-
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SELSYN MOTORS MAGSLIP Mk. II	52/6 ea.
No. 19 2-way radios, complete with hand set, power supply, leads, etc,	£17/10/
Meggers, bridge type, complete and tested	£37/10/-
EVERSHED and VIGNOLES. 500 volts.	

BINOCULARS

PRISMATIC Coated Lenses.
Brand new. Complete with case.

8 x 30	£9	15	0
7 x 50	£13	5	0
10 x 50	£13	15	0
12 x 50	£14	5	0

Post., N.S.W., 7/-: Interstate, 12/-.

SPECIAL ARMY RELEASE

TELESCOPES

ALL LENSES "ASTRONOMICAL" QUALITY

General and Marine Use

4 x 40 Genuine HANDLEY. Cost £30. Our Price . £3/5/
7 x 40 GENUINE OTWAY ANGLE TELESCOPE. Cost £45. Our Price £4/18/6
15 x 40 variable Power Otway, £7/15/.

Freight payable at nearest attended Railway Station.

LENSES

Achromatic Coated 2 Element Air spaced Unmounted.
Astronomical Quality
Make your own telescope or long-focus Camera Lens and save many pounds.

Diam.	Focal Length.	
2½in	36in	£6/19/6
2in dia.,	8in F.L. uncoated.	£2/10/.

Post 3/3 extra.

RECORDING TAPES

SCOTCH BRAND
EX WOOMERA
SLIGHTLY USED
PERFECT ORDER.

Can be used for home video, tape recording equipment, etc.
2,400ft 12in Reel ½in Top Grade. Cost £7/5/. Our Price £3/15/ roll, Post 7/: Interstate 9/6.
Also same in ¼in. Ideal for professional quality audio recording.
1200ft 7in reel ¼in 27/6. Post 1/2
600ft 5in reel ¼in 16/9. Post 1/2
200ft 3in reel ¼in 6/6. Post 1/-

SCOOP PURCHASE

Gramo Motors, New. Made in U.S.A. 40/ each. 240 volt AC, 50 cyc. Only 27/6 each.
Post N.S.W. 3/. Interstate 4/.

240-100 VOLT 6KVA TRANSFORMERS

Encased, including switches, as new, £25.

LEAD ACID BATTERIES

New 2 volt 1.5 amp 17/6. 12 volt 0.75 amp 37/6.
Post N.S.W. 2/6. Interstate 3/.

SPECIAL lucky dip valve offer. 12 new valves in cartons for only £1. We haven't got time to sort them, so you reap the benefit.

Receiver A.M.R. 101 A.W.A. Complete 2 to 25 MEGS with power supply and tested — £55

Receiver A.M.R. 101 A.W.A. Complete 2 to 25 MEGS with power supply 1 coil box £29/10/

Receiver National H.R.O. Complete with power supply and box £29/10/

Rectifier Unit:
415V 3 phase Input
Output 130 to 175 volts DC variable in 10 Steps. 10 Amps. Has Voltmeter, ammeter. D/P Knife. S/W for DC control 3 phase O/L circuit breaker for .. £55
Ideal for charging electric Fork Lifts, etc.

TYPE 22 VIBRATOR

Power Supply less relay, output 200 volts at 125 milliamps with 12 volt synchronous vibrator. 35/.

DEITCH BROS.

70 OXFORD ST., SYDNEY
Between Crown and Riley Streets, City.
SORRY NO C.O.D.

new spots is equal, the old sunspot cycle is reckoned to have ended.

Sunspots are violent eruptions on the face of the sun. The particles erupted, when about 200 miles above the earth, cause ionisation to take place to form the "ionosphere," the mirror which reflects high frequency radio waves. When the sunspot count is low the ionosphere is weak and only the lower frequencies give good long-distance short-wave reception.

The past cycle, the 19th to be measured, took 11 years to complete. It began with a low point in April, 1954, with the number of sunspots 3, and reached its peak in March, 1958, with 201 sunspots, which was something of a record.

No differences in reception will be noticed this year of change but, by early next year, some marked differences in short-wave reception will be apparent. In 1968 or 1969 the peak will be reached, with the higher frequencies being widely used by short-wave stations for international broadcasting.

Radio Nederlands, Hilversum, Holland. The studio buildings from which originate the Radio Nederland world-wide service, and the popular Happy Station program carried in its Sunday transmissions.

BROADCAST BAND NEWS

CANADA—The recent shift in frequency by the N.Z.B.C. station in Gisborne from 1010 to 1060 closed one channel and opened another. On 1010KC it allowed the Canalian Broadcasting Corporation regional station in Calgary, Alberta, to be well received with its 50KW signal in the early evenings around 0700GMT. Two other new Canadians have also been noted, CJRN on 1600KC in Niagara Falls, Ontario (heard mixed with 3NE Wangaratta, Victoria in the evenings in New Zealand) and CFOX in Montral, Q. on 1470KC. This is a 5KW station which is on the air 24 hours a day, with programs of Country and Western music and with a news bulletin at 0725GMT. Another CBC station, CBE in Windsor, Ontario, using 1550KC which is a clear channel, in Australia and New Zealand, and the only unoccupied frequency in this area, is also heard at 0700 with an all-night music program.

INTERMATIONAL WATERS—The first vertification reported in Australasia of the new Radio Caroline on 1496KC has come from Robert Roani, of Sydney; the station verifies with a letter. Radio Caroline, South formerly Radio Atlanta, broadcast from the M.V. Mi Amigo, off Harwich, east-north-east of London, and puts 10KW into a 142ft vertical folded unipole. The station address is Radio Caroline, Chesterfield Gardens, London, W.1. Peter Drew in Western Australia has also verified this station operating from international waters.

FLASHES FROM EVERYWHERE

TAHITI has made a slight move in frequency and is now on 6140KC from 6135KC for its service in French and Tahitian. The station is using the broadcast band channel of 1400KC, which also gives fair reception in New Zealand, as well as its two short wave outlets, 6140 and 11825KC. The station operates Monday to Saturday 0330-0730, 1515-1715, 2130-2300; on Sunday the schedule is 0330-0800- 2000-2300.

SWEDEN'S new frequency for the broadcast from Stockholm for the Far East has given fair reception on 15440KC from opening at 1230 in English. The station generally follows its opening news bulletin with a commentary; on Wednesday at 1245GMT "Sweden Calling DXers" is broadcast.

OLAND'S transmission from Warsaw to listeners in Africa is on the air in English 1200-1230 and 1300-1330 and in French 1230-1300 and 1330-1400, using 7125, 11840 and 15150KC. A further transmission follows in English from 1830 to 1900 hours GMT, on 7285 and 9675KC. Still later, English is heard at 2200 and French at 2230 on 6005, 7125, 7145, 7285 and 11840KC. It has been noted in Europe that, at 1200, Warsaw uses the frequency of 11840KC with two transmissions beamed in the direction of Africa and Asia.

REECE has resumed its Foreign Service from Athens and has reinstated the two transmissions which were cancelled some years ago. It is on the air with French 1730-1745 and English 1745-1800 on 11730 and 15245KC. Greece is a difficult country to hear and the reintroduction of English sessions may aid listeners.

ADIO MALI with its transmissions from the West African country, and its studios located in Bamako, is now on the air with extended schedule. Full postal address is P.O. Box 171, Bamako, West Africa. The station operates Monday to Friday 0600-0800, 1200-1400, 1800-2300; Saturdays 1200-1830, 1830-2300, 0800-1430; Sunday. 1730 to 2300 GMT. The station in the first transmission in the mornings, in Mali, uses 9745, 4835, 4785KC, in the afternoon 9745, 7280 and, for the evening transmission to sign-off, 9745, 4835, 4785KC. The information came from Ern Suffolk in South Australia.

ETHIOPIA station E.T.L.F., with transmissions from Addis Ababa, is now using 11875KC for its Arabic service from 1700-1825. Signals are good on this channel and the sign-off announcement is in English.

BECHUANALAND station ZNB has ceased operation and has been replaced by ZND, on the air weekdays 1530-1700 on 3356KC. A new station at Gaberones is under construction with 10KW and 1KW transmitters and has been allocated the frequencies of 3356, 4836, 5965 and 7220 for four hours of transmission each day in the English and Tswana languages.

FAROE ISLANDS, which is under control of the Danish Government, is to have a new private radio station on shortwave. The station is now under construction in Klakvsig, according to the World Radio Handbook.

TURKEY is well received with the relay of the Home Service of Radio Ankara, on 15160KC at 0700. The station is on the air 0300 to 1245 on 15194 as well as 15160KC but, at times, the latter channel is not on the air for the full transmission time.

TANZANIA has a new International service from Dar-es-Salaam, which is now heard from 1900GMT when its transmission commences with news in English. Before this time, the home program is carried on the frequency of 5050KC. The new external broadcast gives fair signals in New Zealand, according to Dene Lynburg of Wellington. The station, in the former Tanganyika, was originally operated by the Tanganyikan Broadcasting Corporation, and used a 20KW transmitter on this frequency.

CHILIAN station CE970, with the call Voice of Chile and the frequency of 9700KC, signs off now at 0430. The station, which also has other frequencies in chain, including 1190KC, verified our reception with a card some months ago, and seems one of the Latin Americans who do verify reports. The other Santiago signal, on 9600KC opening at 1000GMT and closing at 0500GMT asks for reports in English, but does not always verify.

MALAGASY Republic with its many frequencies and transmitters, is now partly commercial both in the French and Malgache. They carry commercial programs, particularly in the midday GMT session. The International Service is now reported on 15270KC with 100KW; the program is beamed to Europe in English French and Malgache. Transmission time 1600-1700 should make reception possible in this area.

MILAWI Broadcasting Corporation is now on the air from 0615-2150 and uses 3395 KC. The program material includes news in English at 0700, 1500, 1800, 2000 and 2150, with special features at 1750,1900 and 2050, according to the Radio Denmark DX Session.

ZAMBIA Broadcasting Corporation at Lusaka in former Northern Rhodesia is carrying its National program, according to the schedule supplied by John O'Sullivan of McLeod, Victoria. From 0355 0630 on 3270, 4911KC; 0630-1200 on 4911 and 6165; 1500-1700 on 4911; 1700 2105 on 3270 and 4911KC. ■

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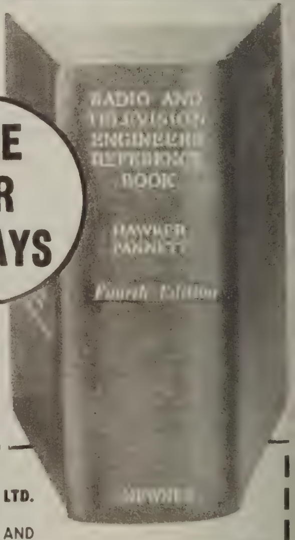

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HEADLIGHT DIPPER

G.McC. (Alderley, Qld.) comments on our par. on this subject on page 105 of the January issue. He says that an article appeared in the October-November issue of "Radio-TV Experimenter" and thinks that it may cause us to modify our ideas.

Thanks for your letter but, frankly, we doubt it. Provision of an over-ride switch and steps to make the unit as compact as possible, with a minimum of interference to the car electrical system, would be a normal part of the design. However, our observations about the real usefulness of such a device, and possible legal implication would, most likely, still stand. We do not see regular copies of the journal in question.

PHOTO TRANSISTOR

P.I. (Ringwood East, Vic.) draws to our notice two or three small circuits in which OC71 transistors are used in light-operated relay systems, the OC71 being rendered photosensitive by scratching the paint off the case.

Circuits of this type are interesting, although not altogether novel. The main problem appears to be that the degree of photosensitivity varies from one transistor to another, since it makes use of a random quality for which the transistors were not originally designed nor tested. With more and more transistors being put out in metal cases, the opportunity to use ordinary transistors in this way is diminishing. Where performance has to be predicted, as in the case of our own projects, the use of a regular phototransistor is much to be preferred. In any case, sensitivity is usually higher.

RECORDERGRAM

R.T. (Yallourn, Vic.), suggests that a worthwhile project would be a stereo recordergram, developed perhaps from the "Playmaster 108" but having tape recording and playback facilities — probably mono.

t could be that such a project would ppeal to readers, R.T., although it might e that many would want stereo tape playack and perhaps even recording facilities. he idea might thus grow into a real monster." However, we shall certainly add he suggestion to our list of possible future rojects, and thank you for your interest. hank you for your good wishes to ELECTRONICS Australia." We can assure ou that we have no intention of neglecting e interests of readers of humbler technical ttainments.

SHORT-WAVE PROBLEM

.D. (Bombala, N.S.W.) queries the reception of short-wave stations at a distance when relatively local ship transmitters are unable to be received. Also he asks what aerial is recommended for short-wave listening.

nfortunately, no mention is made in your letter of the frequencies on which the ship stations are operating. While some of the small-boat frequencies are in the 4 to 5 megacycle region, others operate at 2.524MC, 2.760MC and 6.280MC, all of which would be outside the tuning range of your receiver. Should the stations which you wish to hear be within the tuning range of your receiver, then the reason for their absence may be adverse propagation conditions over the distance, frequency and time of day. All these factors have to be considered in short-wave listening. Also bear in mind that transmissions from these boats would be of short duration and at irregular intervals. Our Basic Radio Course has explained the phenomenon of radio wave propagation and we would suggest the acquisition of back copies of this course for self-study. The best results are obtained with an aerial resonant for the frequency in use but the aerial on page 51 of our March issue would be well worth considering.

ANSWER MAN

G.D.B. (Caringbah, N.S.W.) says he is very keen on our journal and submits some questions for "Answer Man."

We are glad to note that you like the magazine. The "Basic Radio Course" is put on one side only of successive pages but it is difficult, at times, to avoid having at least some other editorial material on the back. Your question about the power ratings of American amplifiers was covered in "Audio Topics" for January, 1964, with a further reference in "Argument" for February, 1965. We have noted your other requests.

LOUDSPEAKER BAFFLING

C.G.R. (Taranaki, N.Z.) compliments us on our design for the "Bookshelf" loudspeaker. He says that he has experimented a good deal with packing in large enclosures but prefers a glass fibre material because it is easily the "warmest" of all such materials and should cause least bass loss due to heat loss. While not having available the materials specified by us, he feels that, had we used the glass fibre, we would have benefited by a substantial lowering of the bass resonance.

Your observations in the first part of the letter confirm our predictions. The thinking is not by any means unique but it has not been widely applied in domestic hi-fi enclosures. We are not so happy with your observations about "warm" materials, since the idea of touching them with the hand indicates heat transmission and insulation properties of the solid, not its inherent temperature, which could be expected to be at ambient in all cases. We frankly doubt whether this property is anything like as important as other physical properties which determine the material's behaviour in the context of an enclosed box. As we stated in the original articles, the materials used had a marked effect on bass resonance and we doubt whether glass fibre would offer any advantage over them. Physically, it is not nearly so pleasant to handle. Wheth your technique of using batts and spacers has any inherent advantage is also open to question. The spaces may be necessary only because your batts have too high a density to start with. With lower-density material, spaces may not be necessary — providing the material does not tend to pack down in use.

VIDEO RECORDING

C.L. (Carlingford, N.S.W.) sends in a photostat copy of an article reporting yet another video recorder for domestic use. He doubts whether the performance claimed could be achieved or maintained in actual production.

Frankly, we do not have any special "inside" information on this subject. When the Telcan story first splashed into the headlines, we expressed grave doubts as to whether home video recording could be done as easily as the stories suggested or that the device could be sold for anything like the quoted figure of 59 guineas. It would appear that our doubts were justified. Since then, quite a few firms have apparently been trying to crack the problems and important progress has been made. While the claims one hears from time to time are less flamboyant than the early ones, we are inclined to think that some of them, at least, still err on the side of optimism. As you say, it is one thing to achieve a certain standard of performance from a lab. prototype; it is quite another to maintain that performance under field conditions. We think that home video recording will come but as the end result of a great deal of hard work and refinement and we doubt whether it will be a cheap facility for quite a while. ■

"ELECTRONICS Australia" INFORMATION SERVICE

TO assist readers, "ELECTRONICS Australia" conducts a technical information service. Conditions governing this service are set out below:—

(1) Address letters to: Assistant Editor, "ELECTRONICS Australia," Box 2728, G.P.O., Sydney.

(2) Requests for copies of circuits or technical information requiring a postal reply must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(3) For the 2/ fee, we will supply circuit data, as available, from our files. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuits will be answered more speedily if they are not complicated by questions requiring the attention of technical personnel Where articles are not on file we can usually provide a photostat copy at 2/ PER PAGE.

(4) The information service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits. Please note that the inclusion of an extra fee does NOT entitle correspondents to special considerations.

(5) The editor reserves the right to return fees or to limit the scope of an individual reply when it is felt that a partial answer will be better than none at all.

(6) In addition to the above service, chassis blueprints are available for most of our projects showing the position of holes and cutouts for metal-working, but containing no details of wiring. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in. x 8in. glossy print, postage 9d extra.

(7) "ELECTRONICS Australia" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications should be obtained from advertisers.

(8) Technical queries are not answered by telephone.

(9) We have no file of circuits for commercial radio or TV sets, etc.

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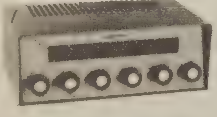

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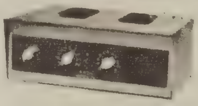

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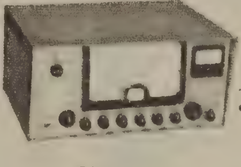

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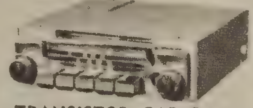

TRANSISTOR CAR RADIO

Push-button operation. High sensitivity. Tailored to fit most modern cars. 6v or 12v operation — state voltage. Polarity and speaker size.

£29 Complete

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5¾" 850ft	1	2	6
3in Mylar L.P. 300ft		10	6
5¾in Mylar L.P. 1150ft	1	7	6
5¾in Mylar D.P. 1650ft	1	17	6
7in P.V.C. 1200ft	1	5	0
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7in Mylar D.P. 2400ft	2	15	0
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8 WATT
8in Units in Waterproof Projection Horns.
15 Ohm Voice Coils.

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In Double Ended Flares. Duolateral Coverage.

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Line Output Transformers to suit. 17/6 extra.

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American Rating. 30 Watts. Voice Coil 16 ohm.

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REFLEX HORNS TO SUIT.

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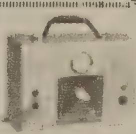

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3 Rate 6V, 12V TRICKLE CHARGE

Trickle Charge Position suits all Batteries. 2V to 12V at rate of 200 to 500 M.A.

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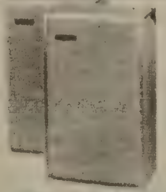

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Cross-over unit £1/12/6.

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Also to suit. 8 W.R. and new Magnavox HF5SIC Tweeter.

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12V Operation.
2 Channel Input.
With mixing 15 ohm output.

15 Watt	£27/15/-
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R. TV & H. STEREO TAPE RECORDER

MARCH-APRIL ISSUE, 1962

Complete kit set as described including Collaro, Stereo Deck. With latest Michigan Heads and required modificatons.

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Steel Cabinet to fit.

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Wired and Tested, Complete in Cabinet with Tape. 2 Dynamic Microphones. Guaranteed.

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TAPE RECORDER SPECIALS 4 TRACK, 3 SPEED, 3 WATTS

Output. Twin Speakers. Complete with mike, and tape. 240 V.A.C. Power.

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Wired and tested.

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R. TV and H., July, August issue. State max. revs., voltage, polarity cylinders.

INCLUDING DWELL, ANGLE FACILITY.

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K 20 CT500

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D.C. Volts, .6, 6, 30, 120, 600, 1200, 3000, 6000 A.C. Volts, 6, 30, 120, 600, 1200. D.C. Current, .06-6, 60, 600mA. Resistance, 6K, 600K, 6meg., 60meg. D.B. minus 20 to plus 62. 5 Ranges. Specially suitable for transistor use.

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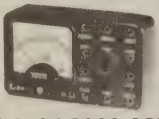

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D.C. Volts, 0, 10, 50, 250, 500, 1,000.
A.C. Volts, 0, 10, 50, 250, 500, 1,000.
M.A. 1-100-500 RESISTANCE.

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Resistance 1 ohm to 1,000 megohm.
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Circuit, operating instructions, graphs and fault indications included.

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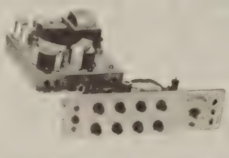

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Tape. Amplifier. May issue. Complete. Stereo Tape. Amplifier. 5 watts per channel.

KIT SET __ £80 **WIRED & TESTED £90**

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12 watts per channel. Equal to 101 amplifier. Wired and tested. Only

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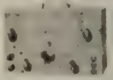

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6 Band, 120 Kc to 390 Megs.
Provision for Crystal.
An Ideal TV Marker Generator.

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2 to 270 megs. 4 bands.
5.5 meg. crystal for sound. I.F. sweep width to 12 megs.

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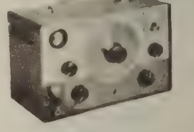

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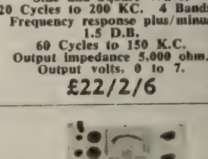

T.E.22 AUDIO GENERATOR

Sine and Square Wave.
20 Cycles to 200 KC. 4 Bands.
Frequency response plus/minus 1.5 D.B.
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Output impedance 5,000 ohm.
Output volts, 0 to 7.

£22/2/6

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Tests all valves, diodes, rectifiers, checking filaments, shorts. Merit on direct reading. Good-bad meter. Complete with tube chart.

£13/7/6

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TECHNICAL BOOKS AND PUBLICATIONS

SURPLUS CONVERSION HANDBOOK (Including Command Sets), by Tom Kneitel. Soft cover, 192 pages, 6 by 9 inches. Filled with circuit diagrams and pictures. Published by Cowan Publishing Corp., Port Washington, N.Y. Australian Price 39/6 plus 1/6 postage.

One of the CQ technical series, this book is crammed full of technical information on surplus radio equipment. While the surplus market here in Australia is fast becoming non-existent, this information will be handy for those amateurs who have surplus gear put aside for future investigation or those who would like to improve the performance of equipment already in use.

After reading the book we were left with the feeling that the title could easily be reversed to read Command sets including other surplus. The major section of the publication deals with conversions of Command transmitters and receivers for all modes, AM, CW, SSB and DSB. Amongst other equipment, old friends such as the SCR522 and BC348 make an appearance.

The book is sectionalised under the following paragraph headings: Complete Stations, Transmitters, Frequency Control, Mobile, Modulation, Interference, Receivers, Power and Miscellaneous.

An excellent reference manual for the owners and/or operators of surplus radio equipment. Our review copy from McGill's Authorised Newsagency, 183 Elizabeth Street, Melbourne.

* * *

THE RADIO AMATEUR OPERATOR'S HANDBOOK, ninth edition, compiled by the staff of The Radio Constructor. Soft cover, 64 pages, 5½ by 8½ inches. Illustrated text material with several tables. Published by Data Publications Ltd., London. Australian price 7/3 plus 8d postage.

While some of the information given in this handbook is only applicable to the British Isles, most of the tables apply throughout the world. Its usefulness is not confined to amateur operators, as shortwave listeners will find within its covers a wealth of knowledge to increase the pleasure of their hobby.

Subjects covered are country prefixes, callsign areas, frequency allocations, standard frequency transmissions, time factors, distance tables and many more. Maps are given showing various call areas throughout the world and even the back cover has been utilised to present a Frequency/Wavelength conversion Abac.

For concise knowledge in this field a few shillings well worth spending. While our review copy came direct from the publishers, copies of the book are available from Electronics Publications, 22 Stanley Street, Peakhurst, N.S.W.

* * *

PHILIPS SCIENTIFIC AND INDUSTRIAL EQUIPMENT BULLETIN for February, 1965 (Vol. 4, No. 7) has major rticles on the Roussel-Jouan Dichrograph, Circular Dichroism and Polarised Light. Many new additions to the Philips range of nstruments, equipment and components are eviewed, while two minor articles deal with he interference microscope and a typical se in examining blood corpuscles. (Scienific and Industrial Equipment Division, Philips Electrical Pty. Ltd., 69-79 Clarence treet, Sydney.)

NATIONAL BUREAU OF STANDARDS TECHNICAL NEWS BULLETIN or February, 1965 (Vol. 49, No. 2) has rticles on a large one-pan balance designed to speed weighing of large loads, measurement of performance of "slow-flow" meters, the heat of formation of Aluminium Carbide, aluminium corrosion protection, diurnal fading of VLF signals and the effects of oxygen and ozone upon asphalt durability. (Sold by Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402. Subscription 2.25 dollars.)

B.B.C. ENGINEERING DIVISION MONOGRAPH No. 56 (December, 1964) deals with the effects of interchannel differences in phase/frequency and amplitude/frequency characteristics upon the transmission of stereophonic information. (B.B.C. Publications, 35 Marylebone High Street, London, W.1. Price 5/- U.K., post free.)

TECNICO ELECTRONICS PTY. LTD. advise the release of new products in their New Product Magazine. This issue contains information on the following equipment: Spectral Filter Sets, Master Slave Manipulators, Hall Effect Gaussmeters, High Impedance Multimeters, Printed Armature DC Servo Motors, Tuneable Bandpass Filters, Microwave Dummy Loads, High Volume Electrostatic Precipitator, Ultrasonic Computor Storage, Electron Beam Power Supply and Portable Transistorised Electrometer. Copies of this publication are available from the Sydney, Melbourne, Brisbane or Adelaide offices on application on business letterhead.

RONALD J. T. PAYNE PTY. LTD. advise that a pulsed ruby laser of 6000 joules energy has been installed at the Physics Department of the University of Sydney. Also to hand are several leaflets giving general details of Electronic Instruments, Lasers, Low Noise Receivers and Solid State Sub-systems. Information on these subjects is available, from Ronald J. T. Payne Pty. Ltd., 12 Whiting Street, Artarmon, by application on commercial letterhead.

JACOBY, MITCHELL AND CO. PTY. LTD., in their April, 1965, issue of New Developments describe several interesting items. Described are: Microwave Phase and Time Detector, Sampling Oscilloscope, Level Measuring Set, VHF Square Wave Generator, Laboratory Power Supply, GM Valve Tester, Blood pH Trolley, Biological Oxygen Meter, Student pH/Millivoltmeter, Portable pH meter, Varactor Modulators, C-band to Ku-band Image Rejection Mixers, LF Frequency and Spectrum Analyser, Cardiac Pacemaker, VTVM, High-Output Pressure Transducer, Universal Manometer and Tachometer "Snorkel." Copies of this publication may be obtained from the offices of Jacoby, Mitchell and Co. Pty. Ltd. in Sydney, Melbourne or Adelaide, by applying on business letterhead.

LITTON INDUSTRIES NEWS BUREAU, NP-1241 news release advises the immediate availability of a brochure describing a new economical 2,500 megacycle instructional TV service for community or district use. Copies are available from Adler Educational Systems Division, 1 LeFevre Lane, New Rochelle, N.Y., U.S.A.

AMALGAMATED WIRELESS VALVE CO. PTY. LTD. advise that all Ignitrons with the international size letter A to D in the range manufactured by English Electric Valve Company Limited at Lincoln, can now be supplied in co-axial construction form. These components are listed in a leaflet just received. Copies of the leaflet or full details of the complete range of Ignitrons are available from Amalgamated Wireless Valve Co. Pty. Ltd., 47 York Street, Sydney.

LITTON INDUSTRIES NEWS BUREAU advises that a data sheet describing a transistorised portable facsimile system for rapid transmission and reception of graphic information is now available from the Westrex Communications division of Litton Industries, 1 LeFevre Lane, New Rochelle, N.Y.

STANDARDS ASSOCIATION OF AUSTRALIA advise that several amendments are now available from all offices of the association in capital cities and Newcastle. These amendments are: Amendment No. 3 to the 1961 edition of part 1 of the SAA wiring rules, C100, C101, C103, C104, C106, C107, C108, C111, C112, C114, C125, C126, C128, C152, C153, C156, C157, C160, C161, C162, C163, C165, C167 and C172.

Also available is the standard recommendations on loading of oil immersed transformers listed as Australian Standard CC10. ▬

JABEL

CORRECTION

The price of the Jabel Panbrake Folder featured on Page 90 March R.T.V. & H. also Page 50 May, ELECTRONICS Aust. is subject to Sales Tax and should read.

£9/15/-

plus 12½% Sales Tax
(where applicable)

WATKIN WYNNE PTY. LTD.
32 Falcon Street, Crows Nest, N.S.W.

*AEGIS EXTENSION SPEAKERS

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A19.

Induction & Dielectric Heating

(Continued from page 14)

material such as graphite must be used. The heat developed in the crucible is then transferred to the charge by conduction. Because carbon has a great affinity for most metals, it is desirable to spray the inner surface of the crucible with a non-reactive refractory such as magnesium oxide.

When metallic materials are treated their good coupling with the work coil makes it posible to use a non-conducting crucible without loss of work coil efficiency. Such crucibles can be of aluminium oxide, magnesium oxide or porcelain. The work coil surrounds the crucible.

A rather interesting application of HF energy to melting is the experiments carried out at the University of Alberta, Canada, in "levitation" melting. Sometimes the charge in a crucible is contaminated by undesirable reactions with the crucible. By specially shaping the work coil and carefully adjusting the power it has been possible to "levitate" or suspend the charge in mid air (or vacuum) so that it does not come into contact with the crucible.

Because of the possibility of highly accurate energy dosage and the cleanliness of the process, high frequency induction heating is extremely effective in refining germanium, silicon, and other metalloids. This is rather an involved process and space does not permit a detailed account of it.

In industry generally the high efficiency, cleanliness and versatility of high frequency induction heating has elevated the process to a high level, and is regarded as one of the most effective tools available. Some of its advantages may be summarised as follows: Selective heating, extremely high heat concentrations, uniform heating, instant starting without warm up, opportunity for mechanical handling, with fast repetition, lower maintenance costs, economy of floor space, no fumes or heating of factory areas and, therefore, better working conditions.

Next month we hope to have something to say about the companion processes of dielectric and microwave heating. ■

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Colour Television

(Continued from page 7)

good colour service — and the 1963 and 1964 trials have provided a valuable spur for further improvements. The majority opinion in the United Kingdom definitely favours the NTSC system, but SECAM is supported by a strong minority of experienced colour engineers. The advantages of PAL are recognised, but the system gains less support in the U.K. largely becaue of the added cost of the receivers.

In Europe, only Holland apart from the U.K., has openly supported NTSC, with the position of all other countries — including the U.S.S.R. — still to some extent uncertain.

Even if a common system is finally chosen, there is a number of problems which will still face British television. The starting of a national colour service is a costly business; there are other calls on available resources, including the expansion of educational television.

A special problem exists for Britain — that of dual-standard colour receivers — unless it is accepted by viewers that a separate black-and-white receiver is retained for watching 405-line V.H.F. transmissions. A dual-standard I.F. amplifier introduces problems of phase linearity.

In no country has the growth of colour television been as rapid as expected, at least during the early years. It has been said that the greatest competitor to colour is black-and-white television. Nevertheless, today, slightly more than a decade after the start of the NTSC service, American colour television has become a major industry, with sales of receivers — which now cost about 2½ times as much as an equivalent black-and-white set — running at roughly one million a year.

On the basis of economics, the U.K. and Europe still have a long way to go before colour is likely to be widely used. But the first and urgent problem is for the national administrations to agree on a single system—and that, as we have indicated, is no easy matter. ■

X-ray Film

(Continued from page 9)

sible with an X-ray sensitive vidicon tube, eliminating the film.

The automatic X-ray reading system was developed by Walter Eppler and Nicholas Szabo, of the L.M.S.C. Electronic Sciences Laboratory and member of the Data Systems and Manufacturin Research Departments.

Szabo points out that the need for th automatic reading method arose from th fact that the human is not entirely satis factory for the task.

Szabo says: "Consistency by even th trained quality control technician is har to achieve. The same film read by tw different inspectors is likely to yiel quite different logs. Moreover, the sam inspector will perform differently, du to fatigue or emotional stresses. I addition, it is very difficult to maintai a high degree of vigilance for extende periods of time.

"The automatic method permits un formity of standards, reduces cost an greatly increases speed.

CLASSIFIED ADVERTISING

Advertisements in these columns cost only 5/ per line, each line contains the equivalent of five words each of nine letters. Minimum size of advertisements is two lines. PAYMENT MUST ACCOMPANY ALL ADVERTISEMENTS EXCEPT THOSE PLACED BY ACCREDITED AGENCIES. Your advertisement for the July issue must reach our office before June 8. Address your advertisement to The Advertising Manager, ELECTRONICS Australia, Box 2728 G.P.O., Sydney.

FOR SALE

EW 9V-1A protected power supply. R.T.V. and H., November 64. £15. Diffraction grating, gives rainbow effects, 3/ sq. in. Hodgson, 32 Garde Street, Toowoomba, QLD.

ELL 6 cu. ft. vented enclosures each containing MSP 12PQ bass and 6PU treble, £30 pair. G. Watson, 302 President Avenue, Gymea, N.S.W.

USTOM-BUILT Power and Audio Transformers, Battery Chargers, Rectifiers, etc. Single or quantity production. Transistor radio and electric motor repairs. General engineering: Tower fabrication, fitting and turning, and sheetmetal work. Parkinson Transformers, P.O. Box 523, South Brisbane. Phone Beenleigh 33.

OR SALE, Communication Receiver, Lafayette HE80, 14 tubes. Receives A.M., F.M., S.S.B., C.W., continuous coverage and band spread all ham bands, including 6 metres. Brand-new and unpacked. Complete with speaker and transformer, £98. Phone Sydney 44-3181.

KAI latest M-8 model, as new, £200. 8 Bayview Street, Bronte, Sydney. 38-3894.

HARFDALE super 8 and RS12DD. Phone Sydney 95-4492, N.S.W.

M.I.L. 2 B (L2B) transistor tape recorder. Good condition. £80 or near offer. 544-4672, VIC.

ODEL Engineer's drill. Bench type. Castings, blue print. Bolton, 72 King Street, Sydney. Catalogue 7/6.

ABCRAFT 605-L, £20. Ortophon SMG212, £12. Both as new. Unit complete with teak base, £34. 337-8163. Melb., Vic.

PEED Control for portable drills, saws., sanders, etc. Maintains pre-set speed under varying loads without torque loss. Housed in unbreakable, shockproof, hard rubber case with carrying handle, suitable for use in workshop or in field. £8/17/6, post free. Carlyle Co. Pty. Ltd., 8 Audrey Street, Balgowlah, N.S.W.

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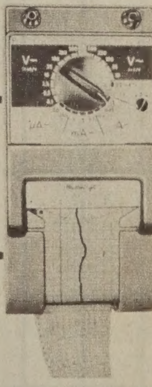

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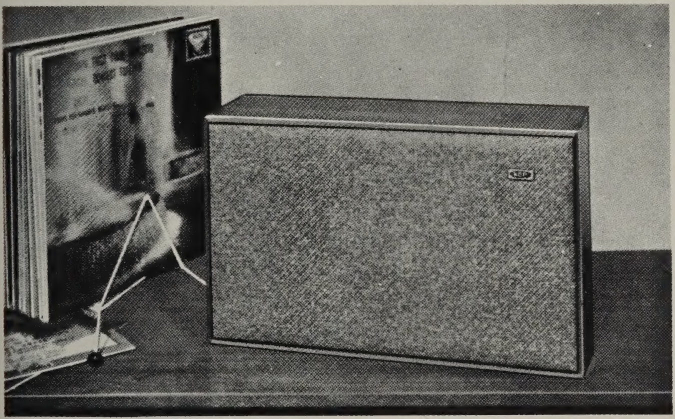

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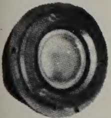

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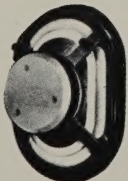

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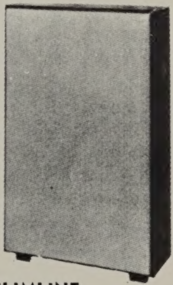

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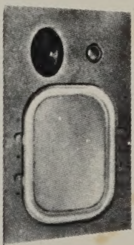

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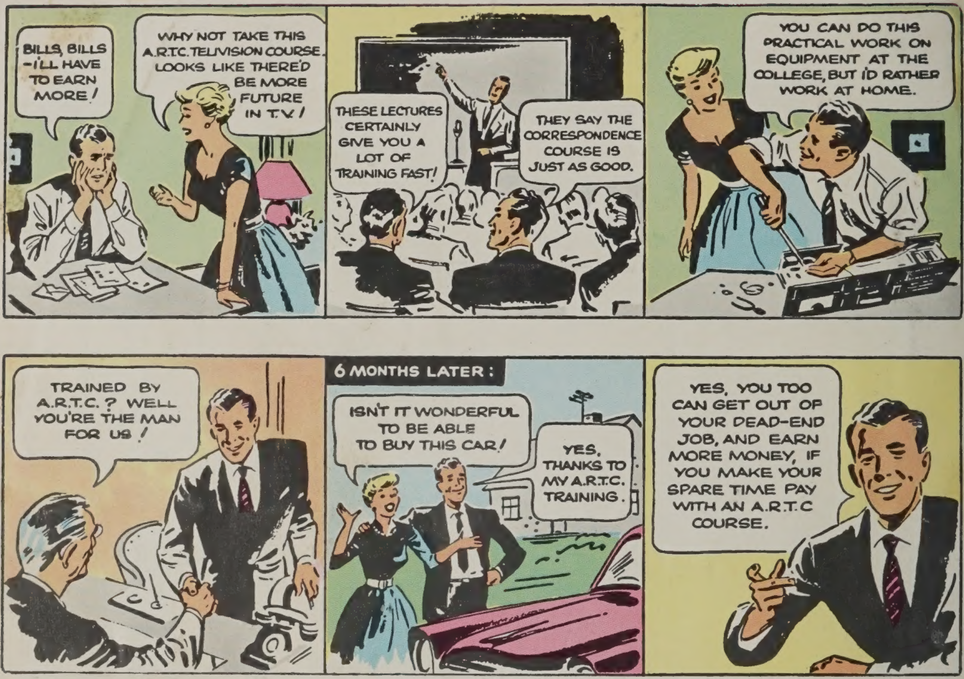
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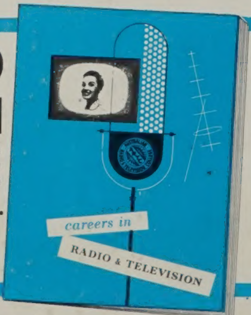

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